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INSTRUCTION MANUAL

SELECTIVE LEVELMETER

MODELS 3121B, 3126B, 3132

# 3121B,3126B,3132

RYCOM
instruments, inc.®

RYCOM INSTRUMENTS
Railway Communications, Inc.
9351 East 59th Street
Raytown, Missouri

# INSTRUCTION MANUAL

## SELECTIVE LEVELMETER

## MODELS 3121B, 3126B, 3132

STANDARD INSTRUMENTS

| MODEL | SELECTIVITY (MEASURE) | COUNTER OUTPUT MODULE | INSTRUMENT SERIAL NO. |
|---|---|---|---|
| 3121B | 100 Hz | YES | |
| 3121B | 250 Hz | NO | |
| 3126B | 250 Hz | NO | |
| 3132 | 100 Hz | YES | |
| 3132 | 250 Hz | NO | |

(Manual No. 3121-341)

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The RYCOM Instruments Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory.

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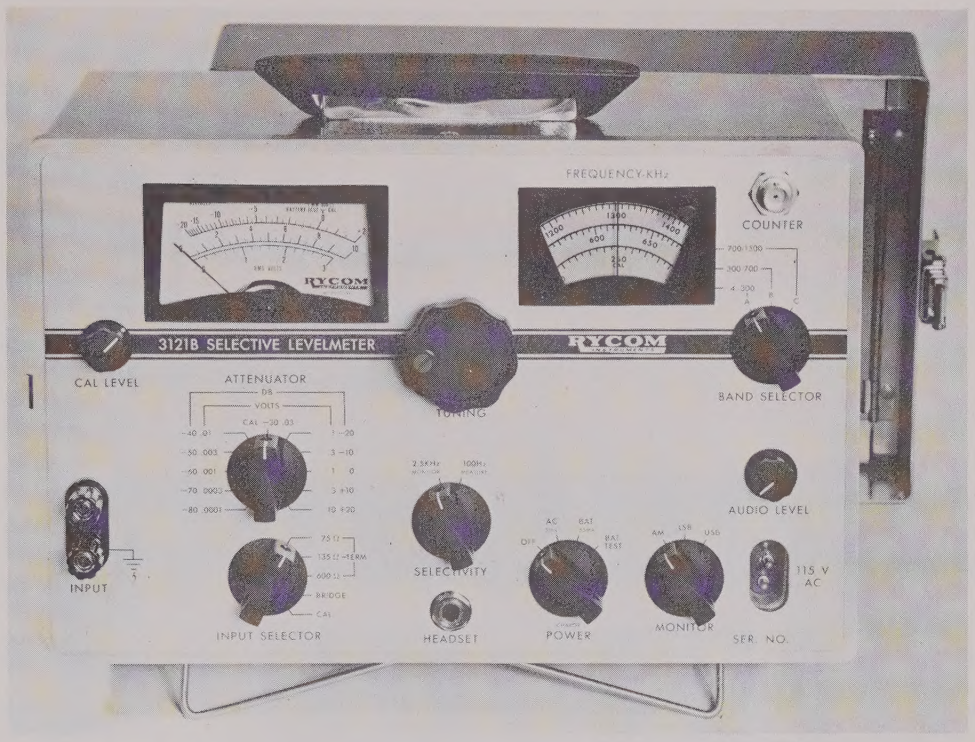


Figure 1
Models 3121B and 3126B Selective Levelmeters

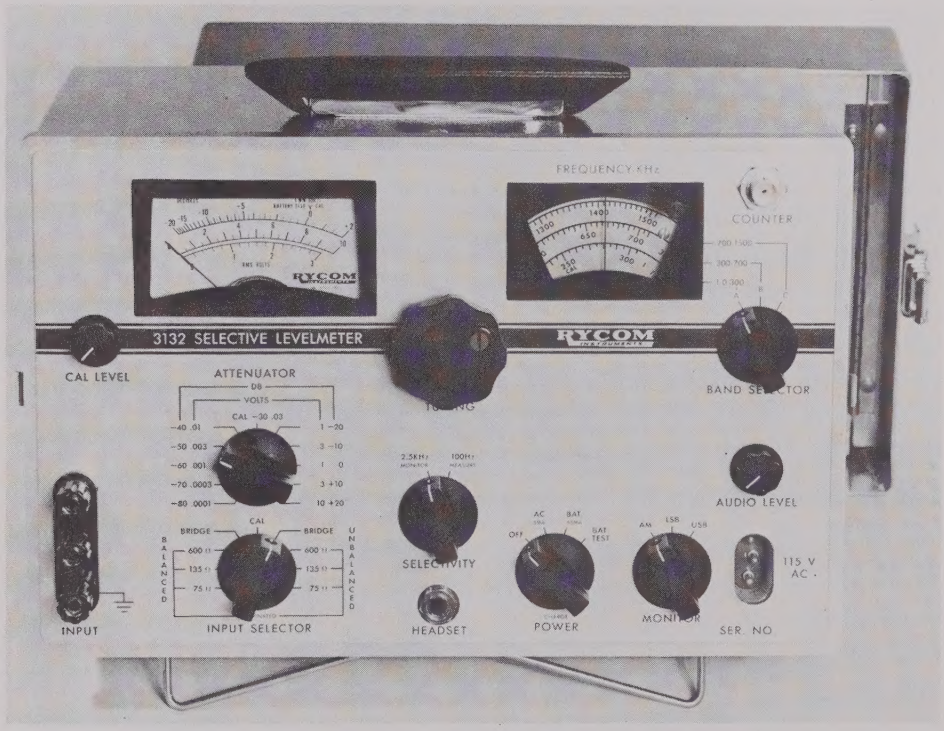



Figure 2
Model 3132 Selective Levelmeter

# CHAPTER I
# GENERAL

## 1. SCOPE.

This manual describes the following RYCOM instruments:

Model 3121B Selective Levelmeter
Model 3126B Selective Levelmeter
Model 3132 Selective Levelmeter

## 2. DESCRIPTION.

All the instruments are intended for general use where it is desired to measure the level of individual or narrow bands of frequencies. Each can be operated with its internal battery, or from 115 volts, 50 to 400 Hz, which is also used to charge the battery.

Table 1 lists the specifications and figures 1 and 2 show the instruments.

The instruments are all fully transistorized. Each measures voltage from 7.75 microvolts to 10 volts (-100 dBm to +22 dBm) in the frequency range 1 to 1500 kilohertz. Excepting Model 3126B (250 Hz only), each instrument has a 100- or 250-Hz bandwidth filter that makes it particularly useful for analyzing closely spaced signals, complex waveforms, determining carrier system levels, and checking amplitude modulation percentages. Included is a 2.5-kHz bandwidth filter that has a ±0.5 dB ripple factor. Special features include an internal oscillator for calibration, a speaker, a headphone jack for aural monitoring, and a built-in battery charger.

A compact metal cabinet 8 inches high, 12 inches wide, and 9 inches deep houses the instrument. Weight, including the battery, is 15 pounds. The front panel contains all the operating controls and is protected by a metal cover that snaps in place. The POWER switch must be set to the OFF position before the cover can be installed, thereby preventing the possibility of battery discharge while the instrument is not in use.

Most of the circuitry is laid out on printed circuit boards and assembled into six separate modules. Extensive shielding is provided for modules and components to prevent interaction between circuits.

The POWER switch is used to select either 115 volts, 50-400 Hz, or an internal nickel-cadmium battery as the power source. The battery will operate the instrument approximately 35 hours without recharging. The instrument will operate on the 115-volt ac line source with or without the battery and regardless of battery condition. A polarized three-pin male connector, on the right side of the front panel, provides access for battery charging and operation from the 115-volt ac source. The instrument may be operated while the battery is charging.

Table 1. Specifications

| NOTE: Except where indicated, specifications apply to all instruments. | |
|---|---|
| CHARACTERISTIC | SPECIFICATION |
| FREQUENCY RANGE | 1 to 1500 kHz (3 bands)<br>Band A: 1 to 310 kHz<br>Band B: 300 to 710 kHz<br>Band C: 690 to 1500 kHz |
| SELECTIVITY | 100 Hz nominal at 3 dB down<br>400 Hz maximum at 60 dB down<br>or<br>250 Hz nominal at 3 dB down<br>1100 Hz maximum at 60 dB down<br>and<br>2500 Hz nominal at 3 dB down<br>10,000 Hz maximum at 60 dB down |
| FREQUENCY ACCURACY | Dial: Band A ±1 kHz<br>Band B ±2 kHz<br>Band C ±3 kHz<br>Counter: All bands ±20 Hz |
| MEASUREMENT ACCURACY | ±1 dB |
| SPURIOUS RESPONSE AND INTERMODULATION PRODUCTS | Greater than 55 db down |
| INTERNAL CALIBRATION SOURCE | 250-kHz crystal oscillator |
| INTERMEDIATE FREQUENCY | 2215 kHz |
| TYPES OF DEMODULATION | AM, LSB, and USB |
| TEMPERATURE RANGE | -10°C to +50°C |
| POWER SUPPLY | 12-volt nickel-cadmium battery or 115 volts, 50 to 400 Hz, for ac operation and for charging battery |
| CURRENT DRAIN | 35 ma average |
| BATTERY LIFE | 35 hours without recharging |
| OVERALL DIMENSIONS | 8 in. high x 12 in. wide x 9 in. deep |
| WEIGHT | 15 lb |
| INPUT LEVEL | -100 to +22 dBm (7.75 uV to 10 V) |

Table 1. Specifications (Cont)

| CHARACTERISTIC | SPECIFICATION |
|---|---|
| INPUT IMPEDANCE | |
| Model 3121B | 75-, 135-, 600-ohm terminating or bridge (5K ohms nominal)--unbalanced when operating from 115 Vac |
| Model 3126B | 135- or 600-ohm bridge--balanced or unbalanced |
| | 135- or 600-ohm terminating--balanced or unbalanced |
| Model 3132 | 75, 135, 600 ohms or bridge--unbalanced |
| | 75, 135, 600 ohms or bridge--balanced |
| METER INDICATION | |
| Model 3121B | DBm on 75-, 135-, and 600-ohm line; volts when calibrated for 600 ohms |
| Model 3126B | DBm on 135- and 600-ohm line; volts with INPUT SELECTOR switch in 600-ohm position |
| Model 3132 | DBm on 75-, 135-, and 600-ohm line; volts when calibrated for 600 ohms |

# CHAPTER II
# OPERATION

## 1. PREPARATION.

The instrument has been thoroughly inspected at the factory and is covered by Warranty. However; before using the instrument, you should inspect it for shipping damage. Report any damage to the carrier and to RYCOM Instruments, Inc.

## 2. OPERATING CONTROLS AND INDICATORS.

Table 2 lists and describes the instrument controls and indicators.

Table 2. Operating Controls and Indicators

| PANEL MARKING | DESCRIPTION | FUNCTION |
|---|---|---|
| BAND SELECTOR | 3-position rotary switch | Selects frequency band A, B, or C |
| TUNING | Driven tuning mechanism, 2-speed | Tunes instrument to frequency indicated on dial face |
| SELECTIVITY | 2-position rotary switch | Selects bandwidth 250 Hz (100 Hz) or 2.5 kHz |
| ATTENTUATOR | 11-position rotary switch | Controls sensitivity in 10-dB steps up to 100 dB |
| CAL LEVEL | Potentiometer | Adjusts overall gain during calibration |
| MONITOR | 3-position rotary switch | Selects AM or single sideband (LSB, USB) demodulation |
| AUDIO LEVEL | Potentiometer | Adjusts audio level for headset |
| HEADSET | Headphone jack | Provision for audio monitoring |
| INPUT | Binding posts (also 20-pin connector on Model 3126B) | Signal input for measurements |

Table 2. Operating Controls and Indicators (Cont)

| PANEL MARKING | DESCRIPTION | FUNCTION |
|---|---|---|
| POWER | 4-position rotary switch, spring loaded in BAT. TEST position | Connects power supply to ac line, battery, or battery test circuit |
| 115 VAC | Polarized connector | Provision for connection to 115-Vac line |
| No marking | 1/4-in. black knob on FREQUENCY dial bezel | Rotates cursor ±5° for frequency correction |
| COUNTER (not on all instruments) | BNC connector | Provision for connection to electronic frequency counter |
| | MODEL 3121B ONLY | |
| INPUT SELECTOR | 5-position rotary switch | 1. Selects input terminations of 75, 135, 600 ohms, or BRIDGE<br>2. Selects CAL position for calibration |
| | MODEL 3126B ONLY | |
| INPUT SELECTOR | 11-position rotary switch | 1. Selects input terminations of 135- or 600-ohm BRG, 135- or 600-ohm TERM for binding posts, and has three IN and OUT positions for 20-pin connector<br>2. Selects CAL position for operational calibration |
| No marking | Shorting link on lower two INPUT binding posts | 1. Provides ground for unbalanced measurements when connected<br>2. Removes ground for balanced measurements when disconnected |
| | MODEL 3132 ONLY | |
| INPUT SELECTOR | 9-position rotary switch | 1. Selects input terminations of BRIDGE, 600-, 135-, or 75-ohm input; BALANCED or UNBALANCED<br>2. Selects CAL position for operational calibration |

3. BATTERY.

The battery will provide up to 35 hours of operation between charges. A completely discharged battery will recharge in 24 hours or less. A routine recharging schedule should be established, dependent upon instrument use, but the battery should be charged at least once per month. (With continuous ac operation, battery charging is unnecessary.)

a. To charge battery, connect instrument to primary power source (115 Vac) and set POWER switch to BAT.

b. To test condition of battery while it is delivering full load current, set POWER switch to BAT. TEST. Battery is fully charged when the meter indicates 0 ±0.5 dBm.

4. CALIBRATION.

This procedure checks the main tuning dial and overall sensitivity. Steps not prefixed with a model number apply to all instruments. Perform all steps in the sequence given, omitting steps that are prefixed with model numbers other than that of your instrument.

a. Set INPUT SELECTOR switch to CAL.

b. Set ATTENUATOR switch to CAL -30 DB.

c. Set SELECTIVITY switch to 250 (100) Hz.

d. Set BAND SELECTOR switch to A.

e. Adjust TUNING control for maximum indication on meter. FREQUENCY dial will indicate approximately 250 kHz.

f. Set red cursor on FREQUENCY dial to 250 CAL.

g. Models 3121B and 3132. To calibrate for dBm (600 ohms) and voltage, adjust CAL LEVEL control for dBm indication on meter.

h. Models 3121B and 3132. To calibrate for dBm (135 ohms), perform steps a through f except step b. (For step b, set ATTENUATOR switch to -20 DB.) Then adjust CAL LEVEL control for -3.5 dBm indication on meter.

i. Models 3121B and 3132. To calibrate for dBm (75 ohms), perform steps a through f except step b. (For step b, set ATTENUATOR switch to -20 DB.) Then adjust CAL LEVEL control for -1 dBm indication on meter.

j. Table 3 is a reference chart for calibration of Models 3121B and 3132.

Table 3. Models 3121B and 3132 Calibration

| CALIBRATION IMPEDANCE | ATTENUATOR | METER INDICATION |
|---|---|---|
| 600 ohms and volts | CAL -30 DB | 0 dBm |
| 135 ohms | -20 DB | -3.5 dBm (red) |
| 75 ohms | -20 DB | -1.0 dBm (red) |

k. Model 3126B. To calibrate, perform steps a through f and adjust CAL LEVEL control for 0 dBm indication on meter. The meter is now calibrated for voltage and dBm (600 ohms) and dBm (135 ohms). See table 5. Red lines on meter do not apply to Model 3126B.

l. A frequency check can be made by tuning the FREQUENCY dial through its range. Meter indications should be observed at every 250-kHz point; e.g., 500, 750, 1000, 1250, and 1500 kHz.

5. LINE MEASUREMENTS, MODELS 3121B (UNBALANCED) AND 3132.

(Model 3121B unbalanced; Model 3132 unbalanced or balanced, depending upon INPUT SELECTOR switch position.)

a. Connect the instrument INPUT to circuit being tested.

b. Calibrate the instrument for source or line impedance according to paragraph 4.

c. Set INPUT SELECTOR switch to desired impedance. See paragraph 7.

d. Set BAND SELECTOR switch and adjust TUNING control to frequency of signal to be measured.

e. Set ATTENUATOR switch so meter indicates in upper 2/3 of scale.

f. Adjust TUNING control for maximum indication on meter.

g. Read meter indication. See table 4. To obtain the input signal level, algebraically add the meter indication to the ATTENUATOR switch setting.

6. MODEL 3121B LINE MEASUREMENTS--BALANCED.

To make balanced line measurements, perform step a or b.

a. Place the instrument face up (resting on the four rubber feet) and remove the ac line cord from the 115 VAC receptacle. Set POWER switch to BAT. position. This places approximately 100 picofarads of unbalance to ground from the ground terminal of the instrument.

b. A balancing transformer, RYCOM Model 3061, can be used. This transformer is optional and can be obtained from RYCOM. See instructions on transformer for use.

After performing step a or b, proceed with measurements described in paragraph 5.

7. INPUT SELECTOR SETTING AND METER CORRECTION, MODELS 3121B AND 3132.

a. INPUT SELECTOR on BRIDGE.

(1) Use this position to connect across a 75-, 135-, or 600-ohm line to make dBm measurements when calibrated for the proper line impedance. For greatest accuracy, apply the correction factors listed in table 4 for BRIDGE.

(2) Use this position to connect across any low-impedance line to make voltage measurements. Calibrate for 600 ohms according to paragraph 4.g.

b. INPUT SELECTOR on 600 Ohms. Use this position to terminate a 600-ohm line to make dBm (1 mW in 600 ohms) or voltage measurements. Calibrate for 600 ohms according to paragraph 4.g.

c. INPUT SELECTOR on 135 Ohms. Use this position to terminate a 135-ohm line to make dBm (1 mW in 135 ohms) measurements. Calibrate for 135 ohms according to paragraph 4.h.

d. INPUT SELECTOR on 75 Ohms. Use this position to terminate a 75-ohm line to make dBm (1 mW in 75 ohms) measurements. Calibrate for 135 ohms according to paragraph 4.i.

Table 4. Models 3121B and 3132 INPUT SELECTOR Setting and Meter Correction

| INPUT SELECTOR | CALIBRATION IMPEDANCE | METER INDICATION | SOURCE OR LINE IMPEDANCE | METER CORRECTION FACTOR |
|---|---|---|---|---|
| BRIDGE (5000 ohms) | 600 ohms | Volts and dBm (600 ohms) | 600 ohms | +0.5 dBm |
| | 135 ohms | dBm (135 ohms) | 135 ohms | +0.3 dBm |
| | 75 ohms | dBm (75 ohms) | 75 ohms | 0 |
| 600 ohms TERM | 600 ohms | Volts and dBm | 600 ohms | 0 |
| 135 ohms TERM | 135 ohms | dBm | 135 ohms | 0 |

Table 4. Models 3121B and 3132 INPUT SELECTOR Setting and Meter Correction (Cont)

| INPUT SELECTOR | CALIBRATION IMPEDANCE | METER INDICATION | SOURCE OR LINE IMPEDANCE | METER CORRECTION FACTOR |
|---|---|---|---|---|
| 75 ohms TERM | 75 ohms | dBm | 75 ohms | 0 |

e. Example: BRIDGE position calibrated for 600 ohms shows meter correction factor of +0.5 dBm. Loading effects of the 5000-ohm voltmeter impedance across 600 ohms gives a meter reading that is 0.5 dBm low due to loading. Therefore, add +0.5 dB to the meter reading for precise measurements.

f. The use of improper TERM positions is discouraged due to improper impedance matching and large errors in the meter reading.

8. MODEL 3126B LINE MEASUREMENTS--INPUT JACKS.

a. Connect instrument INPUT jacks to circuit to be tested. For unbalanced lines, use shorting link. For balanced lines, disconnect shorting link.

b. Calibrate instrument according to paragraph 4.

c. Set INPUT SELECTOR switch to desired impedance.

d. Set BAND SELECTOR switch and adjust TUNING control to frequency of signal to be measured.

e. Set ATTENUATOR switch so meter indicates in upper 2/3 of scale.

f. Adjust TUNING control for maximum indication on meter.

g. Read meter indication. See table 5. To obtain the input signal level, algebraically add the meter indication to the ATTENUATOR switch setting.

9. MODEL 3126B LINE MEASUREMENTS--20-PIN CONNECTOR.

The 20-pin INPUT connector is provided for bridging onto 135-ohm balanced carrier lines of Western Electric N or ON carrier. To perform 135-ohm carrier line measurements, proceed as follows:

a. Patch instrument to circuit to be tested.

b. Calibrate instrument according to paragraph 4.

c. Set INPUT SELECTOR switch as required for circuit to be measured.

d. Set BAND SELECTOR switch and adjust TUNING control to frequency of signal to be measured.

e. Set ATTENUATOR switch so meter indicates in upper 2/3 of scale.

f. Adjust TUNING control for maximum indication on meter.

g. Read meter indication in dBm. To obtain the input signal level, algebraically add meter indication to ATTENUATOR switch setting.

10. INPUT SELECTOR SETTING AND METER CORRECTION, MODEL 3126B.

The calibration given in paragraph 4.k serves for measurements on both 135- and 600-ohm lines.

a. INPUT SELECTOR on 135 Ohms BRG. Use this position to connect across a 135-ohm line to make dBm (1 mW in 135 ohms) measurements. For precise measurements, see meter correction factor in table 5.

b. INPUT SELECTOR on 600 Ohms BRG. Use this position to connect across a 600-ohm line to make dBm (1 mW in 600 ohms) or to connect across any low-impedance line to make voltage measurements. For precise measurements, see meter correction factor in table 5.

c. INPUT SELECTOR on 135 Ohms TERM. Use this position to terminate a 135-ohm line to make dBm (1 mW in 135 ohms) measurements.

d. INPUT SELECTOR on 600 Ohms TERM. Use this position to terminate a 600-ohm line to make dBm (1 mW in 600 ohms) or voltage measurements.

e. INPUT SELECTOR on IN or OUT Positions. Use these positions to connect across the 135-ohm balanced lines of Western Electric N or ON carrier to make dBm (1 mW in 135 ohms) measurements. (See paragraph 9.)

Table 5. Model 3126B INPUT SELECTOR Setting and Meter Correction

| INPUT SELECTOR | CALIBRATION IMPEDANCE | METER INDICATION | METER CORRECTION FACTOR |
|---|---|---|---|
| 135 ohms TERM | *600 ohms | DBm from 135-ohm source | 0 |
| 135 ohms BRG | *600 ohms | DBm from 135-ohm source | +0.3 dBm |
| 600 ohms BRG | *600 ohms | Volts from any low impedance source and dBm from 600-ohm source | +0.5 dBm |
| 600 ohms TERM | *600 ohms | Volts or dBm from 600-ohm source | 0 |

*This is equivalent to 600 ohms calibration impedance in other units but not selectable in Model 3126B. The example given in paragraph 7.e applies to Model 3126B also.

11. MONITORING.

Provision is made for monitoring audio signals that may be present on line signals under measurement. To monitor signals, set SELECTIVITY switch to 2.5 KHz, set MONITOR switch to desired position (AM, LSB, or USB), and adjust AUDIO LEVEL control to the desired audio level.

12. COUNTER OUTPUT.

The counter is normally supplied with 100-Hz instruments.

a. Using a short length of coaxial cable, connect the instrument COUNTER output jack to the input of a frequency counter with the following minimum characteristics:

Sensitivity: 0.1 V
Input Impedance: 10,000 ohms

NOTE

If the frequency counter has variable gate and display times, proceed with steps b and c.

b. Using Counter to Replace Instrument FREQUENCY Dial.

(1) Set counter GATE TIME to 0.01 second.

(2) If counter has MEMORY control, turn it on.

(3) Adjust counter DISPLAY control for minimum display time.

(4) Counter indicates frequency setting of the instrument ±100 Hz.

c. Using Counter as a Tuned-to-Frequency Readout.

(1) Carefully adjust TUNING control so meter indicates maximum (peaked).

(2) Set frequency counter GATE TIME to 0.1 second.

(3) Adjust frequency counter DISPLAY control for a display time as short as possible but easily readable.

(4) With a 100-Hz filter in the instrument, the frequency counter indicates the frequency to which the instrument is tuned ±20 Hz.

d. A counter with fixed 1-second gate time can also be used. Tuning to and measuring a frequency is a little slower but just as accurate.

# CHAPTER III
# THEORY OF OPERATION

## 1. GENERAL.

The instrument employs a single conversion superheterodyne circuit with a selectable bandpass of 250 (100) Hz or 2.5 kHz to measure frequencies in the range 1 to 1500 kHz. Figure 11 is a functional block diagram of the instrument and figure 12 is the basic schematic diagram without the counter output module. Figures 12A, 12B, and 12C show the different input circuits of the three models. Figure 13 is a schematic diagram of the counter output module.

At the input of the instrument, a switch is used to select the input signal from either the 250-kHz calibrate oscillator or from the front panel INPUT jacks. A filter and matching network are incorporated into the input circuit to attenuate unwanted high-frequency components and to provide proper impedances.

A variable attenuator provides up to 100 dB of attenuation in 10-dB steps tc control sensitivity of the instrument. Tuning of the instrument is accomplished by a variable local oscillator whose output varies from 2216 to 3715 kHz. The input and local oscillator signals are heterodyned in a mixer to produce a 2215-kHz difference frequency. The i-f amplifier is tuned to 2215 kHz and it amplifies the mixer output.

The 250 (100)-Hz and 2.5-kHz selectivities of the instrument are determined by crystal filters between the first and second i-f amplifiers. After amplification by the i-f amplifier, the signal is rectified and filtered in a meter detector circuit and then applied to a meter.

The second detector, when used with insertion frequency of 2213.5 kHz and 2216.5 kHz will produce single sideband demodulation for audio monitoring.

The calibrate oscillator generates a 250-kHz square wave and is amplitude-regulated to provide an output level that is equivalent to -30 dBm at the INPUT jacks. Before measurements are made, the instrument sensitivity is calibrated by connecting the calibrate oscillator output to the instrument input circuits and adjusting the i-f amplifier gain for a meter indication of 0 dBm.

When the instrument is used for power measurements, the variable attenuator is used to change sensitivity in calibrated steps of 10 dB. For example, assume that a signal level of -42 dBm is applied to the instrument input. Adjusting the ATTENUATOR to the -40 DB position will result in meter indication of -2 dBm. The input level is then determined by algebraically adding the meter indication to the attenuator setting:

$$-40 \text{ dB} + (-2 \text{ dBm}) = -42 \text{ dBm}$$

2. INPUT MODULE A1.

The input circuits are composed of INPUT SELECTOR switch S1 and a 100-dB ATTENUATOR A1AT1. Input signals are applied to INPUT binding posts A1E1 and A1E2. All models have 5000 ohms input impedance.

In Models 3121B and 3132, resistor A1R1, A1R2, or A1R3 is switched into the circuit by A1S1 to terminate 75-, 135-, or 600-ohm lines. In Model 3126B, resistor A1R2 or A1R3 is switched into the circuit by A1S1 to terminate 135- or 600-ohm lines.

In Model 3126B, resistors A1R4 and A1R5 form a 6.5-dB L-pad, and are switched into the circuit in INPUT SELECTOR positions 600 Ohms BRG or 600 Ohms TERM for measurements on 600-ohm impedance lines. This allows one calibration to serve for both 135-ohm and 600-ohm dBm measurements.

3. EMITTER-FOLLOWER AND CALIBRATE OSCILLATOR MODULE A2.

The function of the emitter-follower with feedback is to match attenuator A1AT1 to lowpass filter FL3.

The calibrate oscillator is 250 kHz, crystal-controlled, and biased so the output voltage swings between the regulated power supply voltage and ground. The output is applied through CAL OSC ADJ potentiometer A2R12 to switch A1S1 for calibrating the instrument level and checking the frequency dial accuracy.

4. LOWPASS FILTER FL3.

The lowpass filter has a cutoff frequency of 1760 kHz and provides 60 dB of attenuation at 2215 kHz. Input and output impedances are 150 ohms.

5. OSCILLATOR-MODULATOR MODULE A3.

The input signal is heterodyned with the local oscillator injection signal in balanced modulator diodes A3CR1. The diodes operate as a balanced shunt modulator, shorting the signal to ground during one-half the local oscillator cycle. The 2215-kHz output of the modulator is capacitively coupled to the base of first i-f amplifier A4Q1.

Modulator driver A3Q1 output is transformer-coupled through A3T1 to the modulator diodes. Local oscillator level at the junction of the modulator diodes is very small due to the matching of components. Input to the modulator driver is capacitively coupled from the emitter of local oscillator A3Q2.

The local oscillator is a modified Colpitts type with three switched frequency bands. The frequency in each band is varied by adjusting TUNING capacitor C1, an 11- to 150-picofarad air-dielectric capacitor. The oscillator circuit is temperature-stabilized by A3C8.

6. IF AMPLIFIER MODULE A4.

The 2215-kHz output of the modulator is capacitively coupled to first i-f amplifier A4Q1. The amplifier and filter driver consists of three stages:

A4Q1, A4Q2, and A4Q3. Total gain is 36 dB. Output of A4Q2 is transformer coupled to A4Q3, the filter driver.

The instrument has two crystal filters which are selected by SELECTIVITY switch A4S4. The center frequency of both filters is 2215 kHz and the bandwidths are 250(100)Hz (A4FL1) and 2.5 kHz (A4FL2) at 3 dB down. Trimmer capacitors A4C7 through A4C10 tune the filters for maximum flatness. Each filter has an input impedance of 4000 ohms and an output impedance of 1000 ohms.

The filter matching amplifier and second i-f amplifier consists of three stages: A4Q4, A4Q5, and A4Q6. Output of the crystal filter is capacitively coupled to filter matching amplifier A4Q4-A4Q5. CAL LEVEL control R2 is used to adjust bias current for A4Q5, thus controlling gain of the stage. The output of A4Q5 drives common-emitter amplifier A4Q6. Second i-f amplifier A4Q6 has a gain of 20 to 40 dB, depending upon the setting of CAL LEVEL control R2.

Third i-f amplifier A4Q7 provides 30 dB of gain and is transformer-coupled to i-f output amplifier A4Q8. Output of A4Q7 is also capacitively coupled to the meter detector circuit.

Meter detector diode A4CR1 is a half-wave detector with its output applied through A4R27 to power switch S7, which is connected to the meter.

I-f output amplifier A4Q8 provides isolation of the carrier reinsertion oscillator signal and also drives demodulator diodes A5CR2 and A5CR3.

7. DEMODULATOR MODULE A5.

The AM demodulator is a shunt type; A5CR3 is the diode. Monitor switch A5S5, when in the AM position, connects the cathode of A5CR3 to ground. Rf filtering is done by A5C10 and A5R15. The audio signal is capacitively coupled from AUDIO LEVEL control R1 to the base of first audio amplifier A5Q5.

The sideband demodulator consists of A5CR2 and A5CR3, which are supplied with carrier signal from A5Q4. These diodes operate as a balanced shunt demodulator that shorts the i-f signal to ground during one-half the injection signal cycle. This produces an audio difference signal that is coupled to the base of first audio amplifier A5Q5.

Carrier reinsertion oscillator A5Q3 is crystal-controlled by A5Y1 or A5Y2. Output is capacitively coupled to balanced phase splitter A5Q4, which supplies out-of-phase signals to demodulator diodes A5CR2 and A5CR3. MONITOR switch A5S5 is used to apply power to A5Q3 and A5Q4, and select the crystal for LSB or USB demodulation. LSB crystal A5Y1 is 1.5 kHz below and USB crystal A5Y2 is 1.5 kHz above the i-f center of 2215 kHz.

8. AUDIO AMPLIFIER MODULE A5.

The audio amplifier is composed of first audio amplifier A5Q5 and audio output amplifier A5IC1, an integrated circuit. The output of the demodulator is fed through rf decoupling network A5R15 and A5C10 to AUDIO LEVEL control R1. Signal at the arm of R1 drives first audio amplifier A5Q5. Gain of audio output amplifier A5IC1 is approximately 28 dB.

9. REGULATOR MODULE A5.

The regulator is a series type, with A5Q1 as the series regulator transistor and A5Q2 the control amplifier. Reference diode A5VR1 (9.1 volts) controls bias for A5Q2. The output of the regulator is also connected through A5R4 to POWER switch S7 for checking battery condition. Nickel-cadmium batteries hold their full voltage throughout the useful life of the charge, thus a meter indication of 0 ±0.5 dBm indicates that the battery charge is adequate for instrument operation.

10. AC POWER SUPPLY AND CHARGER MODULE A6.

The ac power supply consists of T1, A6CR1, A6C1, A6R1, and A6VR1. Voltage applied to the regulator and to the audio amplifiers on module A5 is preregulated by A6VR1. The ac power supply also supplies charging current of approximately 65 milliamperes to the battery when POWER switch S7 is in the BAT. position. When the POWER switch is in the AC position, A6R2 is connected in series with the battery to supply a trickle charge of approximately 5 milliamperes and isolate the battery from the preregulated line.

11. COUNTER OUTPUT MODULE A7.

Module A7 is usually installed in instruments with 100-Hz selectivity but it can be ordered with 250-Hz instruments. The purpose of the module is to provide an output signal for accurate frequency measurements by an external electronic frequency counter.

Figure 13 is the schematic diagram of the counter module.

A signal from local oscillator module A3 is connected through coaxial cable to E1 of module A7. The signal goes through isolation amplifiers A7Q1 and A7Q2 to pin 1 of product detector A7IC1. Transistor A7Q5 and associated components form a crystal-controlled oscillator that is adjustable over the i-f of 2215 kHz. The output of this injection oscillator is coupled to pin 2 of A7IC1.

The output at pin 8 of A7IC1 is the product of the local oscillator and the injection oscillator outputs, and is applied to lowpass filter A7L2-A7L3. Only the difference frequency is passed and applied to amplifier A7Q3. Transistor A7Q4 provides a low output impedance through A7C12 to COUNTER output connector J3 on the front panel of the instrument.

Counter output signal accuracy depends upon the accuracy of centering within the bandpass of the 100-Hz filter.

# CHAPTER IV
# MAINTENANCE

## 1. INTRODUCTION.

This instrument will give comparatively trouble-free performance provided normal operating procedures are observed. In the event of any malfunction, first check the battery by turning the POWER switch to the BAT. position and observing the meter for an indication of 0 ±0.5 dB.

Before attempting to trouble shoot the instrument, you should study Chapter III, Theory of Operation. The trouble-shooting procedure consists of three parts:

Isolation to a particular module
Module trouble shooting
Transistor voltage checks

## 2. TEST EQUIPMENT.

The test equipment of table 6 is required to test and align the instrument, but it is not supplied.

Table 6. Test Equipment

| NAME | USE | REQUIRED CHARACTERISTICS |
|---|---|---|
| Sweep Generator and Display Unit | Align i-f amplifiers and crystal filters | 1. Center frequency between 50 and 500 kHz<br>2. Sweep width variable from 5 to 40 kHz<br>3. Sweep rate: 1/sec. to 4/sec. |
| Vtvm | | Triplett 850 or equivalent |
| Frequency Counter | | 1. Minimum counting rate 3000 kHz<br>2. Gate time 1 sec. and 0.01 sec.<br>3. Variable display time |
| Signal Generator | | Hewlett-Packard 651 or equivalent |
| Ac Vtvm | | Ballantine 303 or equivalent |

3. TROUBLE SHOOTING.

Before proceeding with step 1 in table 7, connect equipment in the test setup shown in figure 3 and perform the following steps:

a. Set instrument switches and controls as follows:

| Switch/Control | Position |
|---|---|
| INPUT SELECTOR | BRIDGE |
| BAND SELECTOR | A |
| TUNING | 250 kHz |
| ATTENUATOR | -60 DB |
| CAL LEVEL | Fully clockwise |
| SELECTIVITY | 2.5 kHz |

b. Adjust signal generator for 0.78-V, 250-kHz output signal.

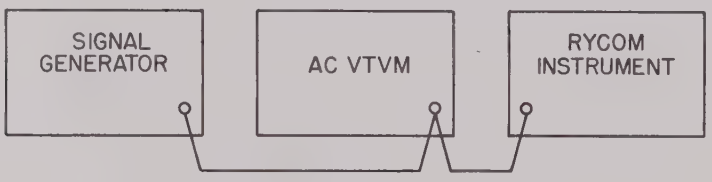



Figure 3
Test Setup for Module Isolation

Table 7. Module Isolation

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Turn unit on. Activate BAT. TEST. | Meter reads 0 ±0.5 dB. | Battery needs recharge or power supply regulator Module A5. See table 8. |
| 2 | Set INPUT SELECTOR to BRIDGE. Connect ac vtvm to pin 7 of Module A2. | Ac vtvm indicates 77 mV. | Trouble is in input Module A1. See table 10. |
| 3 | Set INPUT SELECTOR to CAL. Connect ac vtvm to pin 7 on Module A2. | Ac vtvm indicates 2.5 mV. | Trouble is in calibrate oscillator on Module A2. See table 12. |

Table 7. Module Isolation (Cont)

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 4 | Set INPUT SELECTOR to BRIDGE. Connect ac vtvm to pin 1 on Module A2. | Ac vtvm indicates 34 mV. | Trouble is in emitter-follower on Module A2. See table 11. |
| 5 | Connect ac vtvm to pin E2 on Module A4. | Ac vtvm indicates 30 mV. | Trouble is in FL3 lowpass filter. See table 13. |
| 6 | Set BAND SELECTOR to A. Tune dial to zero frequency. | Instrument meter indicates past full scale. | Trouble is in Module A3. See table 14. |
| 7 | Tune dial to 250 kHz and obtain 0 dB meter reading. Set ATTENUATOR to +10 DB. Connect ac vtvm to E6 on Module A4. | Ac vtvm indicates 0.15 V. | Trouble is in Module A4. See table 15. |
| 8 | Connect ac vtvm to E10 on Module A5. Set MONITOR switch to LSB; AUDIO LEVEL to 2/3 cw. | Ac vtvm indicates 0.14 V. | Trouble is in reinsertion oscillator Module A5. See table 16. |
| 9 | Connect ac vtvm to E12 on Module A5. | Ac vtvm indicates approx. 4 V. | Trouble is in audio amplifier Module A5. See table 17. |

Table 8. Regulator Module A5 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Connect vtvm to E1 on Module A5. | Vtvm indicates 11.5 to 13.5 Vdc. | Check battery connections. Battery needs recharging. |
| 2 | Connect vtvm to E1 on Module A5. Set POWER switch to BAT. | Vtvm indicates 11.5 to 13.5 Vdc. | Check switch S7 and connections. |

Table 8. Regulator Module A5 Trouble Shooting (Cont)

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 3 | Connect vtvm to E7 on Module A5. Set POWER switch to BAT. | Vtvm indicates 9.1 Vdc. | Check A5Q1 and A5Q2 voltages. See table 18. |

Table 9. Power Supply and Charging Circuit Module A6 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Connect vtvm to cathode of A6VR1. Connect power cord to 115 Vac. Set POWER switch to AC. | Vtvm indicates 13.5 to 16.5 Vdc. | Check A6CR1, A6C1, A6R1 and A6VR1. |

Table 10. Input Module A1 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set INPUT SELECTOR to BRIDGE. Connect ac vtvm to coaxial lead from S1 to AT1 on Module A1. Set ATTENUATOR to -80 DB. | Ac vtvm indicates 0.78 V. | Check A1C1 and switch A1S1 connections for continuity. |
| 2 | Set INPUT SELECTOR to BRIDGE. Connect ac vtvm to pin 7 on Module A2. Set ATTENUATOR to -80 DB. | Ac vtvm indicates 0.78 V. | Check A1S2. |

Table 11. Emitter-Follower Module A2 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set signal generator to 250 kHz at -30 dBm and connect to pin 7 of Module A2. Connect ac vtvm to pin 1. | Ac vtvm indicates 11 mV. | Check A2Q1, A2Q3, and A2Q4 voltages. See table 18. |

Table 12. Calibrate Oscillator Module A2 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set INPUT SELECTOR to CAL. Connect ac vtvm to pin 4 on Module A2. | Ac vtvm indicates 26 mV. | Check A2Q2 voltages. See table 18. |

Table 13. Lowpass Filter FL3 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set signal generator to 250 kHz at 24.5 mV and connect to IN on FL3. Connect ac vtvm to OUT on FL3. | Ac vtvm indicates 22 mV. | Check continuity of FL3. |
| 2 | Connect ohmmeter from pin IN to OUT on FL3. | Ohmmeter indicates 2 ohms. | Trouble is in FL3. |

Table 14. Local Oscillator Module A3 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Connect ac vtvm to junction of A3R1 and A3CR1. | Ac vtvm indicates 0.55 V. | Check A3Q1 and A3Q2 voltages. See table 18. |
| 2 | Connect ac vtvm to junction of A3R5 and A3R6. | Ac vtvm indicates between 0.15 and 0.3 V. | Check A3Q2 voltages. See table 18. |

Table 15. I-f Amplifier Module A4 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set signal generator to 2215 kHz at -100 dB (7.75 uV) and connect to E2 on Module A4. Rotate CAL LEVEL fully cw. Set SELECTIVITY to 2.5 kHz. | Instrument indicates -6 dBm. | Adjust A4T1, A4T2, and A4T3 for maximum indication on meter. Check A4Q1 thru A4Q8 voltages. See table 18. |

Table 16. Reinsertion Oscillator Module A5 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set MONITOR to LSB. Connect ac vtvm to base of A5Q4. | Ac vtvm indicates 0.75 V. | Check A5Q3 voltages. See table 18. Check crystals. |
| 2 | Connect ac vtvm to junction of A5C8 and A5R13. | Ac vtvm indicates 0.5 V. | Check A5Q4 voltages. See table 18. |

Table 17. Audio Amplifier Module A5 Trouble Shooting

| STEP | PROCEDURE | NORMAL INDICATION | IF INDICATION IS ABNORMAL |
|---|---|---|---|
| 1 | Set signal generator to 1 kHz at 20 mV and connect to E10 on Module A5. Rotate AUDIO LEVEL control R1 fully cw. Connect ac vtvm to collector of A5Q5. | Ac vtvm indicates 150 mV. | Check A5Q5 voltages. See table 18. |
| 2 | Connect ac vtvm to E12 on Module A5. | Ac vtvm indicates 4 V. | Check A5IC1 voltages. See table 19. |

Table 18. Transistor Voltage Chart

Set instrument controls:

1. No signal input
2. CAL LEVEL fully cw
3. MONITOR to LSB
4. INPUT SELECTOR to CAL

Readings taken with vtvm and should be ±10%.
All voltages positive with respect to chassis ground.

| MODULE | TRANSISTOR | EMITTER | BASE | COLLECTOR |
|---|---|---|---|---|
| A2 | Q2 | 2.3 | 2.1 | 6.0 |
| | Q3 | 9.0 | 7.8 | 1.70 |
| | Q4 | 1.1 | 1.70 | 9.0 |
| | Q1 | Source = 1.1 | Gate = 0 | Drain = 8.4 |
| A3 | Q1 | 1.85 | 2.3 | 6.8 |
| | Q2 | 1.6 | 2.0 | 8.0 |
| A4 | Q1 | 3.3 | 3.9 | 9.5 |
| | Q2 | 2.6 | 3.3 | 9.5 |
| | Q3 | 1.35 | 2.0 | 4.6 |
| | Q4 | 1.9 | 2.5 | 9.0 |
| | Q5 | 1.2 | 1.9 | 3.6 |
| | Q6 | 2.2 | 2.8 | 8.9 |
| | Q7 | 0.9 | 1.5 | 8.8 |
| | Q8 | 1.5 | 2.2 | 5.0 |

Table 18. Transistor Voltage Chart (Cont)

| MODULE | TRANSISTOR | EMITTER | BASE | COLLECTOR |
|---|---|---|---|---|
| A5 | Q1 | 9.5 | 10.3 | 12.0 |
| | Q2 | 0 | 0.65 | 10.3 |
| | Q3 | 1.3 | 1.5 | 3.5 |
| | Q4 | 1.7 | 2.0 | 7.8 |
| | Q5 | 0.4 | 1.0 | 5.0 |
| A7 | Q1 | 1.0 | 1.66 | 9.47 |
| | Q2 | 0.4 | 1.0 | 9.47 |
| | Q3 | 0.46 | 1.0 | 6.22 |
| | Q4 | 5.6 | 6.22 | 8.74 |
| | Q5 | 5.8 | 5.5 | 9.4 |

Table 19. Integrated Circuit Voltages

| INTEGRATED CIRCUIT | PINS 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Test conditions are same as those given in table 18. | | | | | | | | | | |
| A5IC1 | — | — | 7.0 | — | — | — | 6.0 | — | 1.3 | 1.3 |
| A7IC1 | 4.2 | 1.45 | — | 0.75 | 4.2 | 9.47 | 4.2 | 8.98 | — | — |

4. ALIGNMENT.

a. Calibrate Oscillator. Due to normal aging, or replacement of parts, it may be necessary to calibrate the levelmeter. This is accomplished by comparing the calibrate oscillator output level with a known external source. Connect the equipment as shown in figure 4, then proceed with steps (1) through (8).

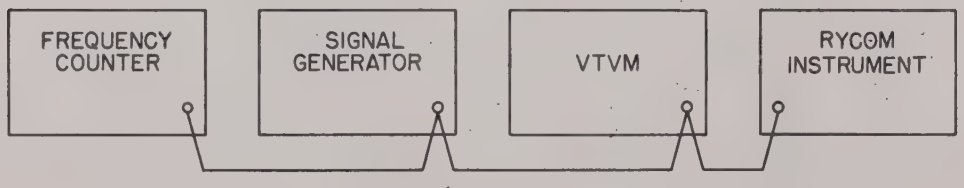



Figure 4
Test Setup for Level Calibration

(1) Set instrument switches and controls:

| Switch/Control | Position |
|---|---|
| INPUT SELECTOR | BRIDGE |
| SELECTIVITY | 250(100)Hz |
| ATTENUATOR | CAL -30 DB |
| BAND SELECTOR | A |
| TUNING | 250 kHz CAL on FREQUENCY dial |

(2) Adjust signal generator frequency to 250 kHz.

(3) Adjust signal generator output level to -30 dBm (24.5 mV).

(4) Adjust TUNING control for maximum indication on meter.

(5) Adjust CAL LEVEL for 0 dBm indication on meter.

(6) Set INPUT SELECTOR to CAL.

(7) Adjust TUNING control for maximum indication on meter.

(8) Adjust CAL OSC ADJ control A2R12 on Module A2 for 0 dBm indication on meter. The instrument is now calibrated and ready for operation.

b. I-f Amplifier. The alignment of the 2215-kHz i-f amplifier, Module A4, is performed by using the internal 250-kHz calibrate oscillator as a signal source. Proceed as follows:

(1) Set instrument switches and controls:

| Switch/Control | Position |
|---|---|
| INPUT SELECTOR | CAL |
| ATTENUATOR | CAL -30 DB |
| SELECTIVITY | 250(100)Hz |
| BAND SELECTOR | A |
| TUNING | Adjust for maximum meter indication |

NOTE

Module A4 cover must be in place before aligning.

(2) Adjust CAL LEVEL (and A4R5 if needed) so meter indicates in upper one-half of scale.

(3) Adjust A4T1, A4T2, and A4T3 with a nonmetallic tuning tool for maximum meter indication.

(4) Adjust CAL LEVEL fully counterclockwise (minimum gain), then adjust A4R5 for -2 dB meter indication.

(5) Check gain range by rotating CAL LEVEL to extreme clockwise position (maximum gain). Meter should indicate approximately +1.5 dB with ATTENUATOR switch set to -20 DB.

c. Crystal Filters A4FL1 and A4FL2. Crystal filters A4FL1 and A4FL2 on Module A4 can be adjusted for passband flatness by using the internal calibrate oscillator. Proceed as follows:

(1) Set instrument switches and controls:

| Switch/Control | Position |
|---|---|
| INPUT SELECTOR | CAL |
| ATTENUATOR | CAL -30 DB |
| SELECTIVITY | 2.5 kHz |
| BAND SELECTOR | A |
| TUNING | 250 kHz CAL on FREQUENCY dial |

(2) Adjust TUNING so meter indicates in valley of passband ripple.

(3) Adjust A4C9 and A4C10 for maximum meter indication.

(4) Repeats steps (2) and (3) until filter A4FL2 passband ripple is within ±0.5 dB.

(5) Set SELECTIVITY to 250(100)Hz.

(6) Adjust TUNING so meter indicates in valley of passband ripple.

(7) Adjust A4C7 and A4C8 for maximum meter indication.

(8) Repeat steps (6) and (7) until filter A4FL1 passband ripple is within ±0.5 dB.

d. Local Oscillator.

(1) Connect equipment as shown in figure 5.

(2) Adjust equipment as follows:

| Switch/Control | Position |
|---|---|
| SIGNAL GENERATOR | 0 dBm level output |
| INPUT SELECTOR | BRIDGE |
| ATTENUATOR | 0 DB |
| SELECTIVITY | 250(100)Hz |
| FREQUENCY dial red cursor | Align with notch in top of FREQUENCY dial bezel opening |

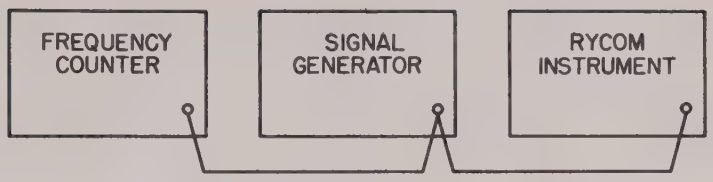



Figure 5
Test Setup for Frequency Alignment

TWO NOTES 02/07/94
CAUTION
CHANGES HAVE BEEN MADE
* ON THIS PAGE.
SEE ISSUE SHEET.
Perits

(3) Band A Alignment.

(a) Set BAND SELECTOR to A.

(b) Adjust signal generator frequency to 50 kHz.

(c) Adjust TUNING for 50-kHz indication on FREQUENCY dial.

(d) Adjust A3L3 for maximum meter indication.

(e) Adjust signal generator frequency to 250 kHz.

(f) Adjust TUNING for 250-kHz indication on FREQUENCY dial.

(g) Adjust A3C14 (A) * RP 02/07/94 for maximum meter indication.

(h) Repeat steps (b) through (g) until FREQUENCY dial tracks within ±1 kHz on band A.

(4) Band B Alignment.

(a) Set BAND SELECTOR to B.

(b) Adjust signal generator frequency to 350 kHz.

(c) Adjust TUNING for 350-kHz indication on FREQUENCY dial.

(d) Adjust A3C16 for maximum meter indication.

(e) Adjust signal generator frequency to 650 kHz.

(f) Adjust TUNING for 650-kHz indication on FREQUENCY dial.

(g) Adjust A3C12 (B) * RP 02/07/94 for maximum meter indication.

(h) Repeat steps (b) through (g) until FREQUENCY dial tracks within ±2 kHz on band B.

(5) Band C Alignment.

(a) Set BAND SELECTOR to C.

(b) Adjust signal generator frequency to 1400 kHz.

(c) Adjust TUNING for 1400-kHz indication on FREQUENCY dial.

(d) Adjust A3C10 for maximum meter indication.

e. Counter Output. Bands A, B, and C must be aligned according to paragraph 4.d before the counter output module can be aligned.

(1) Very carefully center the signal in the bandpass of the 100-Hz crystal filter by adjusting signal generator frequency for peak indication on the meter. Note frequency counter indication.

(2) Remove cover from counter Module A7.

(3) Connect frequency counter to COUNTER jack.

(4) Carefully adjust A7C13 in counter module for the same frequency as noted in step (1). Frequency should be within ±20 Hz of that noted.

(5) Replace cover on counter module.

# CHAPTER V
# PARTS LIST

## 1. HOW TO ORDER PARTS.

When ordering parts, always include:

a. Name, model, and serial number of the instrument.
b. Module and reference designation.
c. Part number.
d. Description.

Order parts from:

RYCOM INSTRUMENTS
9351 East 59th Street
Raytown, Missouri 64133

Telephone 816-353-2100

NOTE: $10.00 minimum on all orders.

## 2. LIST OF MANUFACTURERS.

Code is listed in parts list under MFR.

| Code | Name and Address |
|---|---|
| 01121 | Allen-Bradley Co.<br>1201 S. 2nd St.<br>Milwaukee, Wisc. 53204 |
| 01295 | Texas Instruments, Inc.<br>Semiconductor-Components Div.<br>13500 N. Central Expressway<br>Dallas, Tex. 75231 |
| 03508 | General Electric Co.<br>Semi-Conductor Products Dept.<br>Electronics Park<br>Syracuse, N.Y. 13201 |
| 03877 | Transitron Electronic Corp.<br>168-186 Albion St.<br>Wakefield, Mass. 01880 |
| 04713 | Motorola Semiconductor Products, Inc.<br>5005 E. McDowell Rd.<br>Phoenix, Ariz. 85005 |
| 05397 | Union Carbide Corp., Lind Div.<br>Kemet Dept.<br>Cleveland, Ohio |
| 06978 | Alladin Electronics<br>Div. of Alladin Ind.<br>705 Murfreesboro Rd.<br>Nashville, Tenn. 37210 |
| 07109 | Oaktron Industries<br>P. O. Box 86<br>Monroe, Wisc. 53566 |
| 07910 | Continental Divice Corp.<br>12515 Chadron Ave.<br>Hawthorne, Calif. 90250 |
| 11236 | CTS of Berne, Inc.<br>406 Parr Rd.<br>Berne, Ind. 46711 |
| 11237 | CTS Keene, Inc.<br>3230 Riverside Ave.<br>Paso Robles, Calif. 93446 |

| Code | Name and Address |
|---|---|
| 13571 | Electronic Research Corp.<br>10005 W. 75th<br>Overland Park, Kans. 66204 |
| 14752 | Electro Cube, Inc.<br>1710 S. Del Mar Ave.<br>San Gabriel, Calif. 91776 |
| 16299 | Corning Glass Works<br>Electronic Components Div.<br>3900 Electronics Dr.<br>Raleigh, N.C. 27604 |
| 18410 | RYCOM INSTRUMENTS<br>RAILWAY COMMUNICATIONS, INC.<br>9351 E. 59th St.<br>Raytown, Mo. 64133 |
| 24655 | General Radio Co.<br>22 Baker Ave.<br>West Concord, Mass. 01781 |
| 29309 | Richey Electronics, Inc.<br>1307 Dickerson Rd.<br>Nashville, Tenn. 37213 |
| 34263 | CTS of Brownsville, Inc.<br>1100 Roosevelt St.<br>Brownsville, Tex. 78520 |
| 44655 | Ohmite Mfg. Co.<br>3601 W. Howard St.<br>Skokie, Ill. 60076 |
| 49956 | Raytheon Co.<br>Lexington, Mass. 02173 |
| 56289 | Sprague Electric Co.<br>North Adams, Mass. 01247 |
| 70903 | Beldon Corp.<br>415 S. Kilpatrick<br>Chicago, Ill. 60644 |
| 71400 | Bussmann Mfg.<br>Div. of McGraw Edison<br>2536 W. University St.<br>St. Louis, Mo. 63017 |
| 71785 | Cinch Mfg. Co. and<br>Howard B. Jones Div.<br>1026 S. Homan Ave.<br>Chicago, Ill. 60624 |
| 72136 | Electro Motive Mfg. Co., Inc.<br>South Park and John Streets<br>Willimantic, Conn. 06226 |
| 72982 | Erie Technological Products, Inc.<br>644 W. 12th St.<br>Erie, Pa. 16512 |
| 74970 | E. F. Johnson Co.<br>299 10th Ave. S. W.<br>Waseca, Minn. 56093 |
| 79089 | RCA Corp, Receiving Tube Div.<br>415 S. 5th St.<br>Harrison, N. J. 07029 |
| 81073 | Grayhill, Inc.<br>561 Hillgrove Ave.<br>La Grange, Ill. 60525 |
| 82389 | Switchcraft, Inc.<br>5555 N. Elston Ave.<br>Chicago, Ill. 60630 |
| 84411 | TRW Capacitor Div.<br>112 W. First St.<br>Ogallala, Nebr. 69153 |
| 87930 | Tower Mfg. Corp.<br>158 Pine St.<br>Providence, R.I. 02903 |
| 91637 | Dale Electronics, Inc.<br>P. O. Box 609<br>Columbus, Nebr. 68601 |
| 95712 | The Bendix Corp.,<br>Microwave Devices Div.<br>Hurricane Rd.<br>Franklin, Ind. 46131 |
| 99848 | Wilco Corp.<br>4030 W. 10th St.<br>P. O. Box 22248<br>Indianapolis, Ind. 46222 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | PARTS LOCATED ON FRONT PANEL OR CHASSIS | | | |
| BT1 | Battery, 12 V, 1.0 amp-hr, nickel-cadmium | 770-00001-00 * ~~41B001KD20~~ | 18410 | 1 |
| C1 | Cap, var, air, 11-150 pF, type L | 167-153-10 | 18410 | 1 |
| FL3 | Filter, lowpass, 1.76 MHz cutoff frequency, 150 ohms input and output impedance | 3121FL3 | 18410 | 1 |
| J1 | Connector, electrical power | H1061-IG | 87930 | 1 |
| J2 | Jack, headset | L-12A | 82389 | 1 |
| J3 | Connector, BNC (used with Module A7) | 4716-1 | 95712 | 1 |
| L1 | Coil, rf, 15.6 uH | 3121L1A | 18410 | 1 |
| L2 | Suppressor, parasitic | 3131L2 | 18410 | 1 |
| LS1 | Loudspeaker | 3A1415 | 07109 | 1 |
| M1 | Multimeter, replacement, 0-200 uA, 500 ohms dc resistance | 3005-41 | 18410 | 1 |
| R1 | Res, var, 25K ±20%, 1/2 W | WM4275A | 11237 | 1 |
| R2 | Res, var, 10K ±20%, 1/2 W | NW8746 | 11237 | 1 |
| R3 | Res, 47 ohms ±5%, 1/2 W, carbon | EB4705 | 01121 | 1 |
| S7 | Switch, rotary, 3-pole, 4-pos, 1-deck | 3131S7 | 18410 | 1 |
| T1 | Transformer, power | 3085-1 | 18410 | 1 |
| WA1 | Cord Assy, power | 17258S | 70903 | 1 |

ONE NOTE CAUTION Pen
CHANGES HAVE BEEN MADE
ON THIS PAGE. 02/07/84
SEE ISSUE SHEET.

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A1 (MODEL 3121B) | | | |
| A1C1 | Cap, 5.0 uF ±20%, 200 wvdc, mylar | X663F50502W | 84411 | 1 |
| A1C2 | Cap, 0.1 uF (-20% +80%), 25 wvdc, ceramic | 5815000Y5U00 104Z | 72982 | 1 |
| A1E1 | Binding Post, red | 29-1-R | 81073 | 1 |
| A1E2 | Binding Post, black | 29-1-B | 81073 | 1 |
| | Mounting Plate, black | 29B11-1 | 81073 | 1 |
| A1R1 | Res, 75 ohms ±5%, 2 W, metal film | Type C-42S | 16299 | 1 |
| A1R2 | Res, 140 ohms ±2%, 1 W at 125°C, metal film | Type C-32 | 16299 | 1 |
| A1R3 | Res, 681 ohms ±1%, 1/4 W at 125°C, metal film | RY65D6810F | 18410 | 1 |
| A1R4 | NOT USED | | | |
| A1R5 | NOT USED | | | |
| A1R6 | NOT USED | | | |
| A1R7 | Res, 6040 ohms ±1%, 1/10 W at 125°C, metal film | RY57D6041F | 18410 | 1 |
| A1R8 | Res, 3400 ohms ±1%, 1/10 W at 125°C, metal film | RY57D3401F | 18410 | 1 |
| A1R9 | Res, 1580 ohms ±1%, 1/10 W at 125°C, metal film | RY57D1581F | 18410 | 1 |
| A1R10 | Res, 4530 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4531F | 18410 | 1 |
| A1R11 | Res, 499 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4990F | 18410 | 1 |
| A1R12 | Res, 4990 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4991F | 18410 | 3 |
| A1R13 | Res, 4870 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4871F | 18410 | 1 |
| A1R14 | Res, 158 ohms ±1%, 1/10 W at 125°C, metal film | RY57D1580F | 18410 | 1 |
| A1R15 | Res, 4990 ohms, same as A1R12 | | | |
| A1R16 | Res, 49.9 ohms ±1%, 1/10 W at 125°C, metal film | RY57D49R9F | 18410 | 1 |
| A1R17 | Res, 4990 ohms, same as A1R12 | | | |
| A1R18 | Res, 15.8 ohms ±1%, 1/10 W at 125°C, metal film | RY57D15R8F | 18410 | 2 |
| A1R19 | Res, 15.8 ohms, same as A1R18 | | | |
| A1S1 | Switch, rotary | 3121S1A | 18410 | 1 |
| A1S2 | Switch, rotary | 3121S2 | 18410 | 1 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A1 (MODEL 3126B) | | | |
| A1C1 | Cap, 5.0 uF ±20%, 200 wvdc, mylar | X663F50502W | 84411 | 1 |
| A1C2 | Cap, 0.1 uF (-20% +80%), 25 wvdc, disc ceramic | 5815000Y5U00 104Z | 72982 | 1 |
| A1C3 | Cap, 33 pF ±5%, 500 wvdc, silver mica | DM15E330J | 72136 | 1 |
| A1E1 | Binding Post, red | 29-1-R | 81073 | 2 |
| A1E2 | Binding Post, same as A1E1 | | | |
| A1E3 | Binding Post, black | 29-1-B | 81073 | 1 |
| | Mounting Plate | 29B32-1 | 81073 | 1 |
| | Shorting Link | 0938-9712 | 24655 | 1 |
| A1J1 | Connector, electrical, 20-pin, Western Electric type KS-14160-L1 | 47B14515 | 71785 | 1 |
| A1R1 | NOT USED | | | |
| A1R2 | Res, 140 ohms ±2%, 1 W at 125°C, metal film | Type C-32 | 16299 | 1 |
| A1R3 | Res, 681 ohms ±1%, 1/4 W at 125°C, metal film | RY65D6810F | 18410 | 1 |
| A1R4 | Res, 2610 ohms ±1%, 1/10 W at 125°C, metal film | RY57D2611F | 18410 | 1 |
| A1R5 | Res, 4530 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4531F | 18410 | 2 |
| A1R6 | NOT USED | | | |
| A1R7 | Res, 6040 ohms ±1%, 1/10 W at 125°C, metal film | RY57D6041F | 18410 | 1 |
| A1R8 | Res, 3400 ohms ±1%, 1/10 W at 125°C, metal film | RY57D3401F | 18410 | 1 |
| A1R9 | Res, 1580 ohms ±1%, 1/10 W at 125°C, metal film | RY57D1581F | 18410 | 1 |
| A1R10 | Res, 4530 ohms, same as A1R5 | | | |
| A1R11 | Res, 499 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4990F | 18410 | 1 |
| A1R12 | Res, 4990 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4991F | 18410 | 3 |
| A1R13 | Res, 4870 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4871F | 18410 | 1 |
| A1R14 | Res, 158 ohms ±1%, 1/10 W at 125°C, metal film | RY57D1580F | 18410 | 1 |
| A1R15 | Res, 4990 ohms, same as A1R12 | | | |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A1 (MODEL 3126B) (Cont) | | | |
| A1R16 | Res, 49.9 ohms ±1%, 1/10 W at 125°C, metal film | RY57D49R9F | 18410 | 1 |
| A1R17 | Res, 4990 ohms, same as A1R12 | | | |
| A1R18 | Res, 15.8 ohms ±1%, 1/10 W at 125°C, metal film | RY57D15R8F | 18410 | 2 |
| A1R19 | Res, 15.8 ohms, same as A1R18 | | | |
| A1S1 | Switch, rotary, 4-pole, 9-pos, 2-deck | 3126S1 | 18410 | 1 |
| A1S2 | Switch, rotary, 4-pole, 11-pos, 4-deck | 3121S2 | 18410 | 1 |
| A1T1 | Transformer, input, 1:1 turns ratio, 9.0 ohms ±10% dc resistance | 3126A1T1 | 18410 | 1 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A1 (MODEL 3132) | | | |
| A1C1 | Cap, 5.0 uF ±20%, 200 wvdc, mylar | X663F50502W | 84411 | 1 |
| A1C2 | Cap, 0.1 uF (-20% +80%), 25 wvdc, ceramic | 5815000Y5U00 104Z | 72982 | 1 |
| A1E1 | Binding Post, red | 29-1-R | 81073 | 2 |
| A1E2 | Binding Post, same as A1E1 | | | |
| A1E3 | Binding Post, black | 29-1-B | 81073 | 1 |
| | Mounting Plate | 29B32-1 | 81073 | 1 |
| A1R1 | Res, 75 ohms ±5%, 2 W, metal film | Type C-42S | 16299 | 1 |
| A1R2 | Res, 140 ohms ±2%, 1 W at 125°C, metal film | Type C-32 | 16299 | 1 |
| A1R3 | Res, 681 ohms ±1%, 1/4 W at 125°C, metal film | RY65D6810F | 18410 | 1 |
| A1R4 | NOT USED | | | |
| A1R5 | NOT USED | | | |
| A1R6 | NOT USED | | | |
| A1R7 | Res, 6040 ohms ±1%, 1/10 W at 125°C, metal film | RY57D6041F | 18410 | 1 |
| A1R8 | Res, 3400 ohms ±1%, 1/10 W at 125°C, metal film | RY57D3401F | 18410 | 1 |
| A1R9 | Res, 1580 ohms ±1%, 1/10 W at 125°C, metal film | RY57D1581F | 18410 | 1 |
| A1R10 | Res, 4530 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4531F | 18410 | 1 |
| A1R11 | Res, 499 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4990F | 18410 | 1 |
| A1R12 | Res, 4990 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4991F | 18410 | 3 |
| A1R13 | Res, 4870 ohms ±1%, 1/10 W at 125°C, metal film | RY57D4871F | 18410 | 1 |
| A1R14 | Res, 158 ohms ±1%, 1/10 W at 125°C, metal film | RY57D1580F | 18410 | 1 |
| A1R15 | Res, 4990 ohms, same as A1R12 | | | |
| A1R16 | Res, 49.9 ohms ±1%, 1/10 W at 125°C, metal film | RY57D49R9F | 18410 | 1 |
| A1R17 | Res, 4990 ohms, same as A1R12 | | | |
| A1R18 | Res, 15.8 ohms ±1%, 1/10 W at 125°C, metal film | RY57D15R8F | 18410 | 2 |
| A1R19 | Res, 15.8 ohms, same as A1R18 | | | |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A1 (MODEL 3132) (Cont) | | | |
| A1S1 | Switch, rotary, 4-pole, 9-pos, 2-deck | 3131S1 | 18410 | 1 |
| A1S2 | Switch, rotary, 4-pole, 11-pos, 4-deck | 3121S2 | 18410 | 1 |
| A1T1 | Transformer, input, 1:1 turns ratio, 9.0 ohms ±10% dc resistance | 3126A1T1 | 18410 | 1 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A2 | | | |
| A2C1 | Cap, 15 pF ±5%, 500 wvdc, silver mica | DM15C150J | 72136 | 1 |
| A2C2 | Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic | 0805030Z5U00 103M | 72982 | 1 |
| A2C3 | Cap, 470 pF ±5%, 500 wvdc, silver mica | DM19E471J | 72136 | 1 |
| A2C4 | NOT USED | | | |
| A2C5 | Cap, 10 uF ±20%, 10 wvdc, tantalum | K10W10 | 05397 | 2 |
| A2C6 | Cap, 0.1 uF (-20%, +80%), 25 wvdc, disc ceramic | 5815000Y5U00 104Z | 72982 | 1 |
| A2C7 | Cap, 10 uF, same as A2C5 | | | |
| A2C8 | Cap, 250 pF ±5%, 500 wvdc, silver mica | DM15E251J | 72136 | 1 |
| A2C9 | Cap, 0.1 uF ±10%, 200 wvdc, metalized mylar | 210B1C104K | 14752 | 1 |
| A2L1 | Coil, rf, 1.0 mH, 34 ohms dc resistance | U102 | 99848 | 1 |
| A2Q1 | Transistor, silicon, N-channel, FET | 400 0000 110 | 18410 | 1 |
| A2Q2 | Transistor, silicon, NPN | RC3710 | 18410 | 2 |
| A2Q3 | Transistor, silicon, PNP | 2N4058 | 01295 | 1 |
| A2Q4 | Transistor, same as A2Q2 | | | |
| A2R1 | Res, 10,000 ohms ±5%, 1/2 W, carbon | EB1035 | 01121 | 2 |
| A2R2 | Res, 1 megohm ±5%, 1/2 W, carbon | EB1055 | 01121 | 1 |
| A2R3 | Res, 680 ohms ±5%, 1/2 W, carbon | EB6815 | 01121 | 1 |
| A2R4 | Res, 390 ohms ±5%, 1/2 W, carbon | EB3915 | 01121 | 1 |
| A2R5 | Res, 1500 ohms ±5%, 1/2 W, carbon | EB1525 | 01121 | 1 |
| A2R6 | Res, 68 ohms ±5%, 1/2 W, carbon | EB6805 | 01121 | 1 |
| A2R7 | Res, 3300 ohms ±5%, 1/2 W, carbon | EB3325 | 01121 | 1 |
| A2R8 | Res, 2200 ohms ±5%, 1/2 W, carbon | EB2225 | 01121 | 1 |
| A2R9 | NOT USED | | | |
| A2R10 | Res, 33,000 ohms ±5%, 1/2 W, carbon | EB3335 | 01121 | 1 |
| A2R11 | Res, 10,000 ohms, same as A2R1 | | | |
| A2R12 | Res, var, 500 ohms ±20%, 1/8 W, comp | 220S501B | 34263 | 1 |
| A2R13 | Res, 100 ohms ±5%, 1/2 W, carbon | EB1015 | 01121 | 1 |
| A2R14 | Res, 1100 ohms ±5%, 1/2 W, carbon | EB1125 | 01121 | 1 |
| A2R15 | Res, 150 ohms ±5%, 1/2 W, carbon | EB1515 | 01121 | 1 |
| A2Y1 | Crystal, 250.0000 kHz | Type CR-46A/ U | 13571 | 1 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A3 | | | |
| A3C1 | Cap, 0.1 uF (-20%, +80%), 25 wvdc, disc ceramic | 5815000Y5U00 104Z | 72982 | 1 |
| A3C2 | Cap, 0.1 uF ±10%, 200 wvdc, metalized mylar | 210B1C104K | 14752 | 3 |
| A3C3 | Cap, 0.1 uF, same as A3C2 | | | |
| A3C4 | Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic | 0805030Z5U00 103M | 72982 | 2 |
| A3C5 | Cap, 0.1 uF, same as A3C2 | | | |
| A3C6 | Cap, 1500 pF ±5%, 500 wvdc, silver mica | DM19E152J | 72136 | 1 |
| A3C7 | Cap, 4000 pF ±5%, 500 wvdc, silver mica | DM19E402J | 72136 | 1 |
| A3C8 | Cap, 47 pF ±5%, 200 wvdc, N470, disc ceramic (temperature coefficient selected as required) | 0805000T2H04 70J | 72982 | 1 |
| A3C9 | Cap, 27 pF ±5%, 500 wvdc, NPO disc ceramic | 0851000C0G02 70J | 72982 | 1 |
| A3C10 | Cap, var, 1.7-20 pF, air dielectric | 193-6-5 | 74970 | 2 |
| A3C11 | Cap, 110 pF ±5%, 500 wvdc, NPO disc ceramic | 0841000C0G01 11J | 72982 | 1 |
| A3C12 | Cap, var, 1.7-20 pF, same as A3C10 | | | |
| A3C13 | Cap, 155 pF ±5%, 200 wvdc, N080 disc ceramic | 0845030U1G01 550J | 72982 | 1 |
| A3C14 | Cap, var, 2.2-34 pF, air dielectric | 193-10-5 | 74970 | 2 |
| A3C15 | Cap, 535 pF ±1%, 500 wvdc, silver mica | DM19E535OF | 72136 | 1 |
| A3C16 | Cap, var, 2.2-34 pF, same as A3C14 | | | |
| A3C17 | Cap, 33 pF ±5%, 200 wvdc, NPO disc ceramic | 0805000C0G03 30J | 72982 | 1 |
| A3C18 | Cap, 0.01 uF, same as A3C4 | | | |
| A3C19 | Cap, 22 pF ±5%, 500 wvdc, silver mica | DM15C220J | 72136 | 1 |
| A3CR1 | Diodes, matched pair | RY3605 | 18410 | 1 |
| A3L1 | Coil, rf, 1.0 mH | U102 | 99848 | 1 |
| A3L2 | Coil, rf, 150 uH | 3150-12 | 99848 | 2 |
| A3L3 | Coil, rf, var, 1.5-3.1 uH | 3121L3A | 18410 | 1 |
| A3L4 | Coil, rf, 150 uH, same as A3L2 | | | |
| A3Q1 | Transistor, NPN | RC3710 | 18410 | 2 |
| A3Q2 | Transistor, same as A3Q1 | | | |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A3 (Cont) | | | |
| A3R1 | Res, 68 ohms ±5%, 1/2 W, carbon | EB6805 | 01121 | 2 |
| A3R2 | Res, 68 ohms, same as A3R1 | | | |
| A3R3 | Res, 680 ohms ±5%, 1/2 W, carbon | EB6815 | 01121 | 1 |
| A3R4 | Res, 1000 ohms ±5%, 1/2 W, carbon | EB1025 | 01121 | 3 |
| A3R5 | Res, 3300 ohms ±5%, 1/2 W, carbon | EB3325 | 01121 | 1 |
| A3R6 | Res, 10,000 ohms ±5%, 1/2 W, carbon | EB1035 | 01121 | 2 |
| A3R7 | Res, 10,000 ohms, same as A3R6 | | | |
| A3R8 | Res, 2700 ohms ±5%, 1/2 W, carbon | EB2725 | 01121 | 1 |
| A3R9 | Res, 1000 ohms, same as A3R4 | | | |
| A3R10 | Res, 1000 ohms, same as A3R4 | | | |
| A3R11 | Res, 47 ohms ±5%, 1/2 W, carbon | EB4705 | 01121 | 1 |
| A3S3 | Switch, rotary | 3121S3A | 18410 | 1 |
| A3T1 | Transformer, balanced demodulator | 58-122-02 | 06978 | 1 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A4 | | | |
| A4C1 | Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic | 0805030Z5U00 103M | 72982 | 6 |
| A4C2 | Cap, 0.1 uF (-20%, +80%), 25 wvdc, disc ceramic | 5815000Y5U00 104Z | 72982 | 10 |
| A4C3 | Cap, 0.1 uF ±10%, 200 wvdc, metalized mylar | 210B1C104K | 14752 | 4 |
| A4C4 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C5 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C6 | Cap, 0.01 uF, same as A4C1 | | | |
| A4C7 | Cap, var, 5-25 pF, 350 wvdc, NPO ceramic | 0557051C0P03 9R | 72982 | 4 |
| A4C8 | Cap, var, 5-25 pF, same as A4C7 | | | |
| A4C9 | Cap, var, 5-25 pF, same as A4C7 | | | |
| A4C10 | Cap, var, 5-25 pF, same as A4C7 | | | |
| A4C11 | Cap, 68 pF ±5%, 500 wvdc, silver mica | DM15E680J | 72136 | 1 |
| A4C12 | Cap, 0.01 uF, same as A4C1 | | | |
| A4C13 | Cap, 0.1 uF, same as A4C3 | | | |
| A4C14 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C15 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C16 | Cap, 0.01 uF, same as A4C1 | | | |
| A4C17 | Cap, 0.1 uF, same as A4C3 | | | |
| A4C18 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C19 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C20 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C21 | Cap, 0.01 uF, same as A4C1 | | | |
| A4C22 | Cap, 0.1 uF, same as A4C3 | | | |
| A4C23 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C24 | Cap, 0.1 uF, same as A4C2 | | | |
| A4C25 | Cap, 0.01 uF, same as A4C1 | | | |
| A4CR1 | Diode, germanium | 1N277 | 03877 | 1 |
| A4FL1 | Filter, bandpass, 2215 kHz, 100-Hz BW (used in units with 100-Hz selectivity) | 3121FL1-106 | 18410 | 1 |
| A4FL1 | Filter, bandpass, 2215 kHz, 250-Hz BW | 3121FL1 | 18410 | 1 |
| A4FL2 | Filter, bandpass, 2215 kHz, 2500-Hz BW | 3121FL2 | 18410 | 1 |
| A4L1 | Coil, rf, 1.0 mH, 34 ohms dc resistance | U102 | 99848 | 3 |
| A4L2 | Coil, rf, 1.0 mH, same as A4L1 | | | |
| A4L3 | Coil, rf, 1.0 mH, same as A4L1 | | | |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A4 (Cont) | | | |
| A4Q1 | Transistor, silicon, NPN (used in units with 250-Hz selectivity) | RC3710 | 18410 | 7 |
| A4Q1 | Transistor, silicon, NPN (used in units with 100-Hz selectivity) | 2N4124 | 04713 | 7 |
| A4Q2 | Transistor, same as A4Q1 | | | |
| A4Q3 | Transistor, same as A4Q1 | | | |
| A4Q4 | Transistor, same as A4Q1 | | | |
| A4Q5 | Transistor, same as A4Q1 | | | |
| A4Q6 | Transistor, silicon, NPN | 2N4124 | 04713 | 1 |
| A4Q7 | Transistor, same as A4Q1 | | | |
| A4Q8 | Transistor, same as A4Q1 | | | |
| A4R1 | Res, 200 ohms ±5%, 1/2 W, carbon | EB2015 | 01121 | 1 |
| A4R2 | Res, 6200 ohms ±5%, 1/2 W, carbon | EB6225 | 01121 | 1 |
| A4R3 | Res, 4300 ohms ±5%, 1/2 W, carbon | EB4325 | 01121 | 1 |
| A4R4 | Res, 10,000 ohms ±5%, 1/2 W, carbon | EB1035 | 01121 | 7 |
| A4R5 | Res, var, 200 ohms ±20%, 1/2 W, carbon | 362Y201B | 11236 | 1 |
| A4R6 | Res, 680 ohms ±5%, 1/2 W, carbon | EB6815 | 01121 | 3 |
| A4R7 | Res, 10,000 ohms, same as A4R4 | | | |
| A4R8 | Res, 2700 ohms ±5%, 1/2 W, carbon | EB2725 | 01121 | 2 |
| A4R9 | Res, 3900 ohms ±5%, 1/2 W, carbon | EB3925 | 01121 | 2 |
| A4R10 | Res, 390 ohms ±5%, 1/2 W, carbon | EB3915 | 01121 | 3 |
| A4R11 | Res, 680 ohms, same as A4R6 | | | |
| A4R12 | Res, 1100 ohms ±5%, 1/2 W, carbon | EB1125 | 01121 | 1 |
| A4R13 | Res, 47,000 ohms ±5%, 1/2 W, carbon | EB4735 | 01121 | 1 |
| A4R14 | Res, 18,000 ohms ±5%, 1/2 W, carbon | EB1835 | 01121 | 1 |
| A4R15 | Res, 10,000 ohms, same as A4R4 | | | |
| A4R16 | Res, 3900 ohms, same as A4R9 | | | |
| A4R17 | Res, 1000 ohms ±5%, 1/2 W, carbon | EB1025 | 01121 | 3 |
| A4R18 | NOT USED | | | |
| A4R19 | Res, 10,000 ohms, same as A4R4 | | | |
| A4R20 | Res, 4700 ohms ±5%, 1/2 W, carbon | EB4725 | 01121 | 1 |
| A4R21 | Res, 1000 ohms, same as A4R17 | | | |
| A4R22 | Res, 10,000 ohms, same as A4R4 | | | |
| A4R23 | Res, 2200 ohms ±5%, 1/2 W, carbon | EB2225 | 01121 | 1 |
| A4R24 | Res, 390 ohms, same as A4R10 | | | |
| A4R25 | Res, 10,000 ohms, same as A4R4 | | | |
| A4R26 | Res, 27,000 ohms ±5%, 1/2 W, carbon | EB2735 | 01121 | 1 |
| A4R27 | Res, 1000 ohms, same as A4R17 | | | |
| A4R28 | Res, 10,000 ohms, same as A4R4 | | | |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A4 (Cont) | | | |
| A4R29 | Res, 3300 ohms ±5%, 1/2 W, carbon | EB3325 | 01121 | 1 |
| A4R30 | Res, 2700 ohms, same as A4R8 | | | |
| A4R31 | Res, 390 ohms, same as A4R10 | | | |
| A4R32 | Res, 680 ohms, same as A4R6 | | | |
| A4R33 | Res, 1000 ohms min., 3000 ohms max. ±5%, 1/2 W, carbon (used in 100-Hz selectivity units only) | EB Type | 01121 | 1 |
| A4R34 | Res, 12,000 ohms ±5%, 1/2 W, carbon (used in 100-Hz selectivity unit only if needed) | EB1235 | 01121 | 1 |
| A4S4 | Switch, rotary, 2-pole, 2-pos, printed circuit type | 3121S4 | 18410 | 1 |
| A4T1 | Transformer, i-f, 2215 kHz | B3807 | 18410 | 3 |
| A4T2 | Transformer, same as A4T1 | | | |
| A4T3 | Transformer, same as A4T1 | | | |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A5 | | | |
| A5C1 | Cap, 10 uF (-10%, +100%), 15 wvdc, dry electrolytic | 30D106G015BA 2 | 56289 | 2 |
| A5C2 | NOT USED | | | |
| A5C3 | Cap, 0.1 uF ±10%, 200 wvdc, metalized mylar | 210B1C104K | 14752 | 1 |
| A5C4 | Cap, 200 pF ±5%, 500 wvdc, silver mica | DM15E201J | 72136 | 1 |
| A5C5 | Cap, 0.1 uF (-20%, +80%), 25 wvdc, disc ceramic | 5815000Y5U00 104Z | 72982 | 3 |
| A5C6 | Cap, 59 pF ±5%, 500 wvdc, silver mica | DM15E590J | 72136 | 1 |
| A5C7 | Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic | 0805030Z5U00 103M | 72982 | 6 |
| A5C8 | Cap, 0.01 uF, same as A5C7 | | | |
| A5C9 | Cap, 0.01 uF, same as A5C7 | | | |
| A5C10 | Cap, 0.01 uF, same as A5C7 | | | |
| A5C11 | Cap, 0.1 uF, same as A5C5 | | | |
| A5C12 | Cap, 0.01 uF, same as A5C7 | | | |
| A5C13 | Cap, 0.01 uF, same as A5C7 | | | |
| A5C14 | Cap, 0.001 uF ±20%, 500 wvdc, disc ceramic | 831000Z5U001 02M | 72982 | 1 |
| A5C15 | Cap, 10 uF ±20%, 10 wvdc, tantalum | K10W10 | 05397 | 1 |
| A5C16 | Cap, 10 uF, same as A5C1 | | | |
| A5C17 | Cap, 22 uF ±20%, 6 wvdc, tantalum | K22W6 | 05397 | 1 |
| A5C18 | Cap, 0.1 uF, same as A5C5 | | | |
| A5CR1 | NOT USED | | | |
| A5CR2 | Diode | 1N277 | 03877 | 2 |
| A5CR3 | Diode, same as A5CR2 | | | |
| A5IC1 | Integrated Circuit | GEL237F1 | 03508 | 1 |
| A5L1 | Coil, rf, 1.0 mH | U102 | 99848 | 1 |
| A5Q1 | Transistor, NPN | 2N3053 | 79089 | 1 |
| A5Q2 | Transistor, NPN | RC3710 | 18410 | 4 |
| A5Q3 | Transistor, same as A5Q2 | | | |
| A5Q4 | Transistor, same as A5Q2 | | | |
| A5Q5 | Transistor, same as A5Q2 | | | |
| A5R1 | Res, 1000 ohms ±5%, 1/2 W, carbon | EB1025 | 01121 | 4 |
| A5R2 | Res, 820 ohms ±5%, 1/2 W, carbon | EB8215 | 01121 | 2 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A5 (Cont) | | | |
| A5R3 | NOT USED | | | |
| A5R4 | Res, 60,400 ohms ±1%, 1/8 W at 125°C, metal film | RY60D6042F | 18410 | 1 |
| A5R5 | Res, 10,000 ohms ±5%, 1/2 W, carbon | EB1035 | 01121 | 1 |
| A5R6 | Res, 2000 ohms ±5%, 1/2 W, carbon | EB2025 | 01121 | 1 |
| A5R7 | Res, 4700 ohms ±5%, 1/2 W, carbon | EB4725 | 01121 | 3 |
| A5R8 | Res, 1000 ohms, same as A5R1 | | | |
| A5R9 | Res, 8200 ohms ±5%, 1/2 W, carbon | EB8225 | 01121 | 1 |
| A5R10 | Res, 2200 ohms ±5%, 1/2 W, carbon | EB2225 | 01121 | 1 |
| A5R11 | Res, 1000 ohms, same as A5R1 | | | |
| A5R12 | Res, 1000 ohms, same as A5R1 | | | |
| A5R13 | Res, 4700 ohms, same as A5R7 | | | |
| A5R14 | Res, 4700 ohms, same as A5R7 | | | |
| A5R15 | Res, 3900 ohms ±5%, 1/2 W, carbon | EB3925 | 01121 | 1 |
| A5R16 | Res, 15,000 ohms ±5%, 1/2 W, carbon | EB1535 | 01121 | 3 |
| A5R17 | Res, 150,000 ohms ±5%, 1/2 W, carbon | EB1545 | 01121 | 1 |
| A5R18 | Res, 15,000 ohms, same as A5R16 | | | |
| A5R19 | Res, 820 ohms, same as A5R2 | | | |
| A5R20 | Res, 390,000 ohms ±5%, 1/2 W, carbon | EB3945 | 01121 | 1 |
| A5R21 | Res, 56,000 ohms ±5%, 1/2 W, carbon | EB5635 | 01121 | 2 |
| A5R22 | Res, 15,000 ohms, same as A5R16 | | | |
| A5R23 | Res, 56,000 ohms, same as A5R21 | | | |
| A5R24 | Res, 180,000 ohms ±5%, 1/2 W, carbon | EB1845 | 01121 | 1 |
| A5S5 | Switch, rotary | 3121S5 | 18410 | 1 |
| A5VR1 | Diode, Zener | 1N960B | 07910 | 1 |
| A5Y1 | Crystal, 2213.5 kHz | 159 | 13571 | 1 |
| A5Y2 | Crystal, 2216.5 kHz | 160 | 13571 | 1 |

PARTS LIST

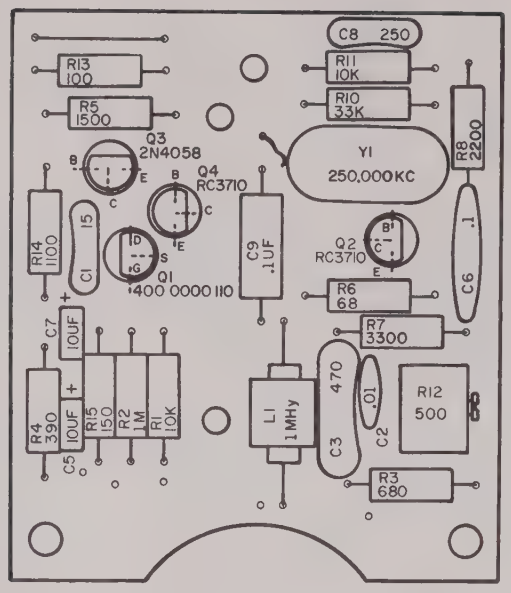
| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A6 | | | |
| A6C1 | Cap, 250 uF (-10%, +100%) at 85°C, 50 wvdc, dry electrolytic | JA-13-250-50 -8P | 29309 | 1 |
| A6CR1 | Diode, full-wave bridge, 1.0 amp, 100 piv | FWBTS3001 | 72982 | 1 |
| A6R1 | Res, 200 ohms ±5%, 5 W, wire-wound | 4599 | 44655 | 1 |
| A6R2 | Res, 820 ohms ±5%, 1/2 W, carbon | EB8215 | 01121 | 1 |
| A6VR1 | Diode, Zener, 15 V ±10%, 10 W | 1N2979A | 04713 | 1 |

PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A7 | | | |
| A7C1 | Cap, 0.01 uF ±20%, 200 wvdc, ceramic | 0805030Z5U00 103M | 72982 | 2 |
| A7C2 | Cap, 0.1 uF (-20%, +80%), 25 wvdc, ceramic | 5815000Y5U00 104Z | 72982 | 2 |
| A7C3 | Cap, 0.22 uF ±20%, 12 wvdc, ceramic | 5615000Y5F00 224M | 72982 | 1 |
| A7C4 | Cap, 10 uF ±20%, 10 wvdc, tantalum | K10W10 | 05397 | 4 |
| A7C5 | Cap, 180 pF ±5%, 500 wvdc, mica | DM15E181J | 72136 | 2 |
| A7C6 | Cap, 250 pF ±5%, 500 wvdc, mica | DM15E251J | 72136 | 2 |
| A7C7 | Cap, 270 pF ±5%, 500 wvdc, mica | DM15E271J | 72136 | 1 |
| A7C8 | Cap, 250 pF, same as A7C6 | | | |
| A7C9 | Cap, 180 pF, same as A7C5 | | | |
| A7C10 | Cap, 10 uF, same as A7C4 | | | |
| A7C11 | Cap, 10 uF, same as A7C4 | | | |
| A7C12 | Cap, 10 uF, same as A7C4 | | | |
| A7C13 | Cap, var, 5.5-18 pF, 350 wvdc, NPO ceramic | 5380115.518A | 72982 | 1 |
| A7C14 | Cap, 30 pF ±5%, 500 wvdc, mica (nominal value) | DM15E300J | 72136 | 1 |
| A7C15 | Cap, 300 pF ±5%, 500 wvdc, mica | DM15E301J | 72136 | 1 |
| A7C16 | Cap, 200 pF ±5%, 500 wvdc, mica | DM15E201J | 72136 | 1 |
| A7C17 | Cap, 110 pF ±5%, 500 wvdc, mica | DM15E111J | 72136 | 1 |
| A7C18 | Cap, 0.01 uF, same as A7C1 | | | |
| A7C19 | Cap, 0.1 uF, same as A7C2 | | | |
| A7IC1 | Integrated Circuit, monolithic, silicon | CA3028A | 79089 | 1 |
| A7L1 | Coil, rf, 1 mH | U102 | 99848 | 2 |
| A7L2 | Coil Assy, 2 incapsulated coils, 28.5 mH and 100 mH | 3071-71 | 18410 | 2 |
| A7L3 | Coil Assy, same as A7L2 | | | |
| A7L4 | Coil, rf, 1 mH, same as A7L1 | | | |
| A7L5 | Coil, rf, 47 uH | 3071-81 | 18410 | 1 |
| A7Q1 | Transistor, silicon, NPN | RC3710 | 18410 | 5 |
| A7Q2 | Transistor, same as A7Q1 | | | |
| A7Q3 | Transistor, same as A7Q1 | | | |
| A7Q4 | Transistor, same as A7Q1 | | | |
| A7Q5 | Transistor, same as A7Q1 | | | |

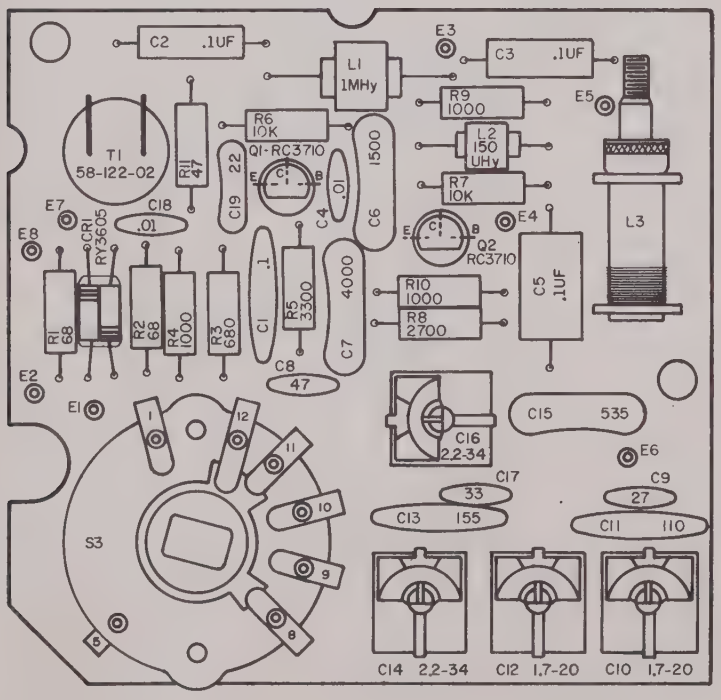
PARTS LIST

| REF DES | DESCRIPTION | PART NO. | MFR | QTY/ ASSY |
|---|---|---|---|---|
| | MODULE A7 (Cont) | | | |
| A7R1 | Res, 270 ohms ±5%, 1/4 W, carbon | CB2715 | 01121 | 2 |
| A7R2 | Res, 18,000 ohms ±5%, 1/4 W, carbon | CB1835 | 01121 | 1 |
| A7R3 | Res, 3900 ohms ±5%, 1/4 W, carbon | CB3925 | 01121 | 1 |
| A7R4 | Res, 1500 ohms ±5%, 1/4 W, carbon | CB1525 | 01121 | 3 |
| A7R5 | Res, 820 ohms ±5%, 1/4 W, carbon | CB8215 | 01121 | 2 |
| A7R6 | Res, 2200 ohms ±5%, 1/4 W, carbon | CB2225 | 01121 | 2 |
| A7R7 | Res, 2200 ohms, same as A7R6 | | | |
| A7R8 | Res, 1000 ohms ±5%, 1/4 W, carbon | CB1025 | 01121 | 1 |
| A7R9 | Res, 820 ohms, same as A7R5 | | | |
| A7R10 | Res, 180 ohms ±5%, 1/4 W, carbon | CB1815 | 01121 | 1 |
| A7R11 | Res, 620 ohms ±5%, 1/4 W, carbon | CB6215 | 01121 | 1 |
| A7R12 | Res, 1500 ohms, same as A7R4 | | | |
| A7R13 | Res, 270 ohms, same as A7R1 | | | |
| A7R14 | Res, 39,000 ohms ±5%, 1/4 W, carbon | CB3935 | 01121 | 1 |
| A7R15 | Res, 10,000 ohms ±5%, 1/4 W, carbon | CB1035 | 01121 | 1 |
| A7R16 | Res, 2700 ohms ±5%, 1/4 W, carbon | CB2725 | 01121 | 1 |
| A7R17 | Res, 100,000 ohms ±5%, 1/4 W, carbon | CB1045 | 01121 | 1 |
| A7R18 | Res, 15,000 ohms ±5%, 1/4 W, carbon | CB1535 | 01121 | 1 |
| A7R19 | Res, 22,000 ohms ±5%, 1/4 W, carbon | CB2235 | 01121 | 1 |
| A7R20 | Res, 4700 ohms ±5%, 1/4 W, carbon | CB4725 | 01121 | 1 |
| A7R21 | Res, 1500 ohms, same as A7R4 | | | |
| A7Y1 | Crystal, quartz, 2215 kHz | 3071-181 | 18410 | 1 |



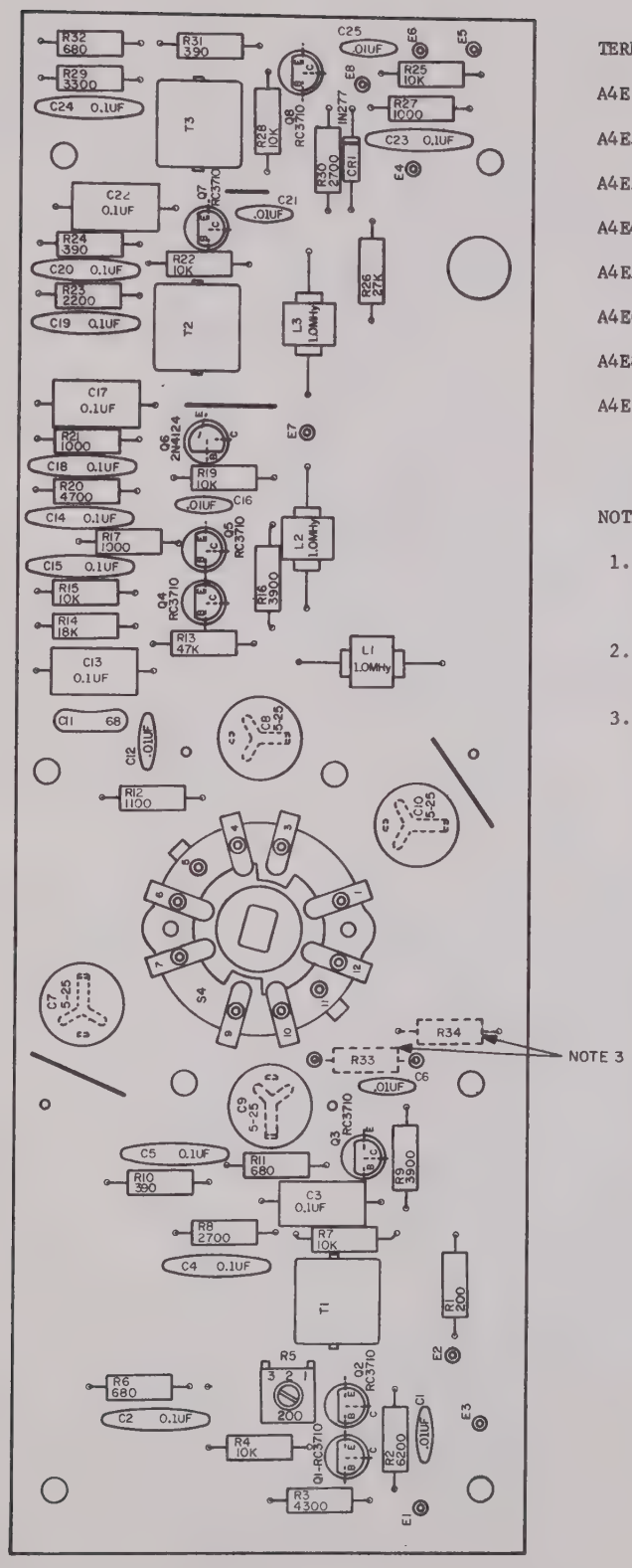

| TERM | WIRE COLOR |
|---|---|
| 1 | COAX |
| 2 | |
| 4 | WHT-GRN |
| 5 | WHT-R |
| 7 | COAX |
| 6 | |
| 8 | RED |

Figure 6
Module A2




| TERM | WIRE COLOR | |
|---|---|---|
| A3E1 | COAX | |
| A3E2 | | |
| A3E3 | L4 | |
| A3E4 | BUS | |
| A3E5 | BUS | |
| A3E6 | BUS | |
| A3E7 | COAX | UNITS WITH MODULE A7 |
| A3E8 | | |

Figure 7
Module A3




| TERM | WIRE COLOR |
|---|---|
| A4E1 | RED |
| A4E2 | COAX |
| A4E3 | BUS |
| A4E4 | WHT-YEL |
| A4E5 | WHT-VIO |
| A4E6 | COAX |
| A4E8 | |
| A4E7 | RED |

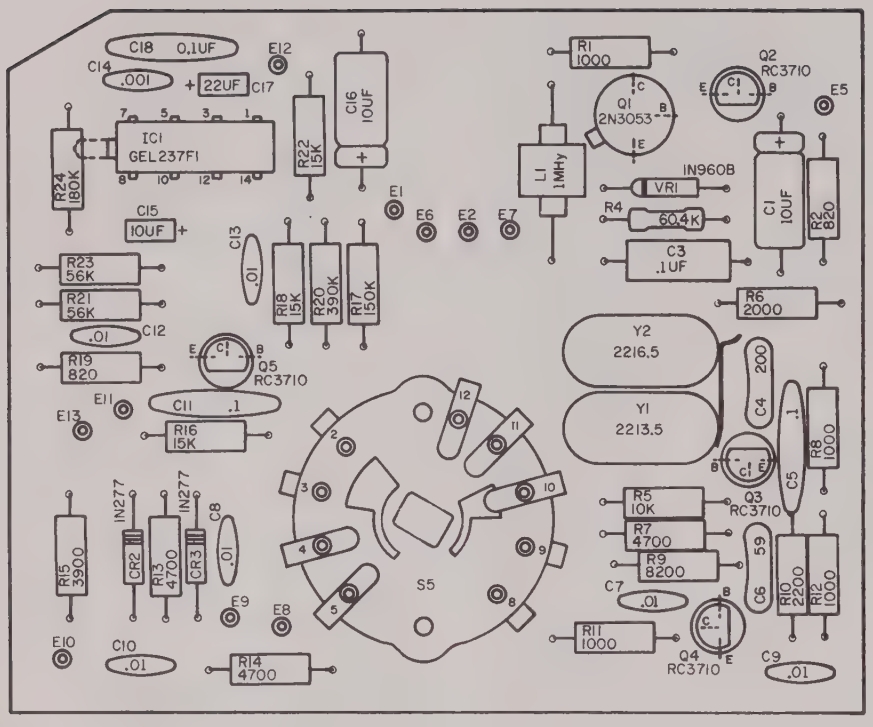
NOTES:

1. 100Hz SELECTIVITY units: Transistors Q1 thru Q8 are type 2N4124 and are positioned same as Q6.

2. Board shown is for 250Hz SELECTIVITY units except as noted.

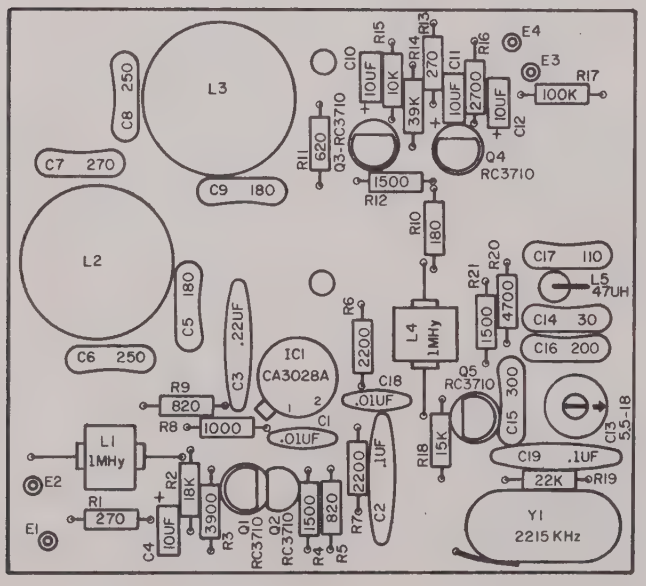
3. R33, R34 used only in units with 100Hz SELECTIVITY. R34 deleted and bus used in place of R33 in units with 250Hz SELECTIVITY.

Figure 8
Module A4




| TERM | WIRE COLOR |
|---|---|
| A5E1 | RED-BLK |
| A5E2 | RED |
| A5E3 | Not used |
| A5E4 | Not used |
| A5E5 | ORN |
| A5E6 | RED |
| A5E7 | RED |
| A5E9 | COAX |
| A5E8 | |
| A5E10 | GRN |
| A5E11 | WHT-GRN |
| A5E12 | BLU |
| A5E13 | BLK |

Figure 9
Module A5




| TERM | WIRE COLOR |
|---|---|
| A7E1 | COAX |
| A7E2 | RED |
| A7E3 | COAX |
| A7E4 | |

Figure 10
Module A7

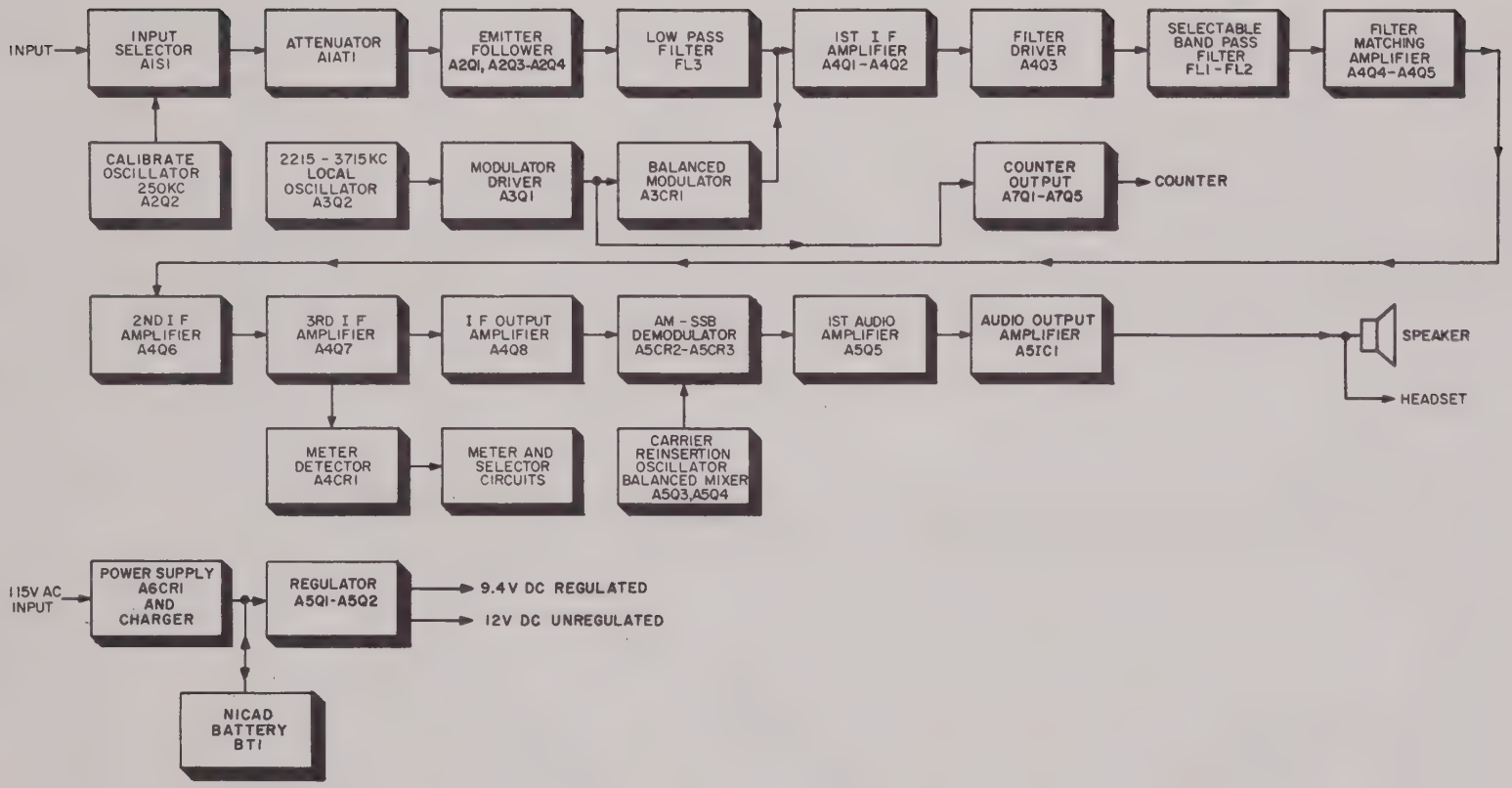
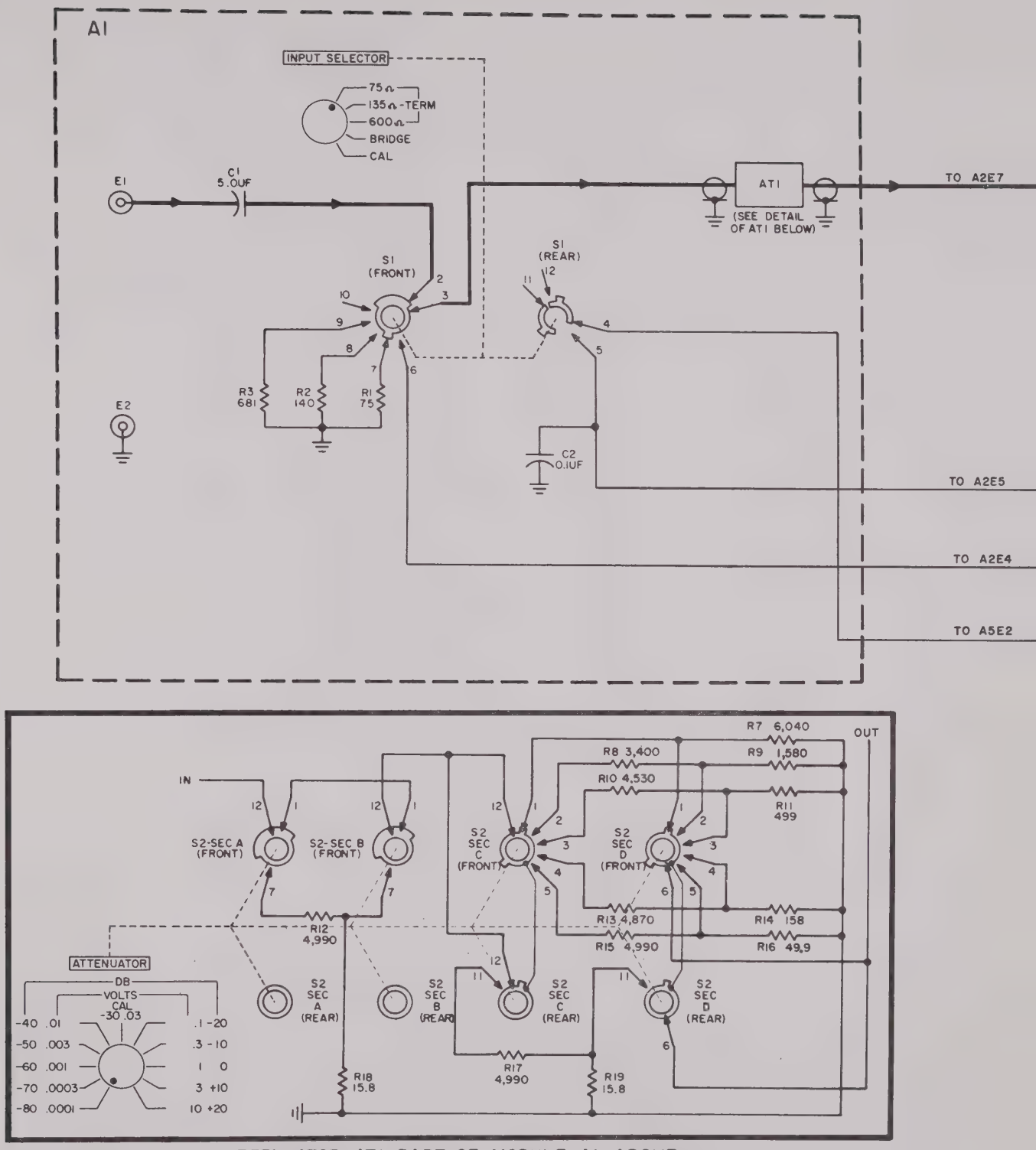
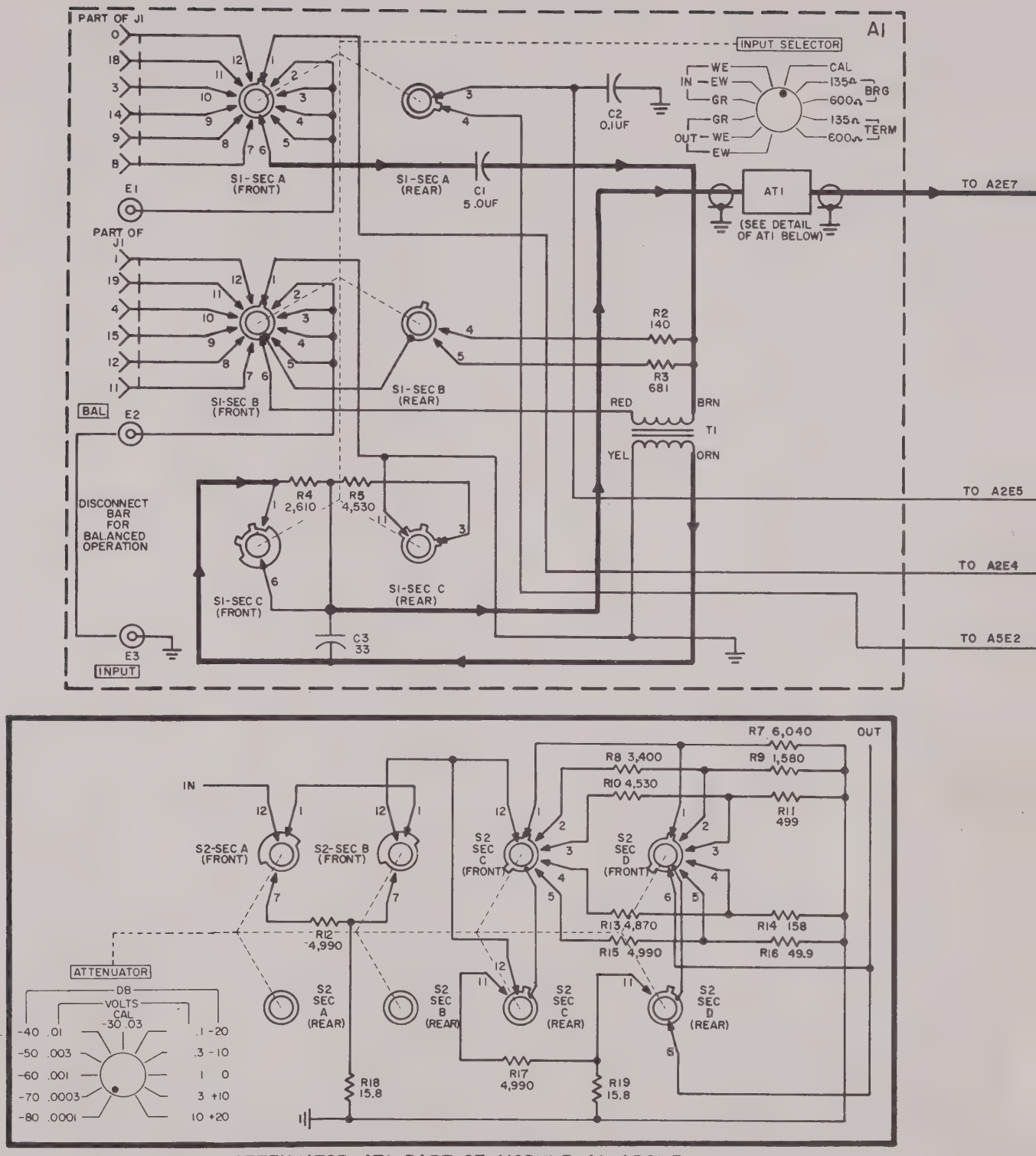



Figure 11
Block Diagram




ATTENUATOR AT1 PART OF MODULE A1 ABOVE

Figure 12A
3121B Input, Schematic

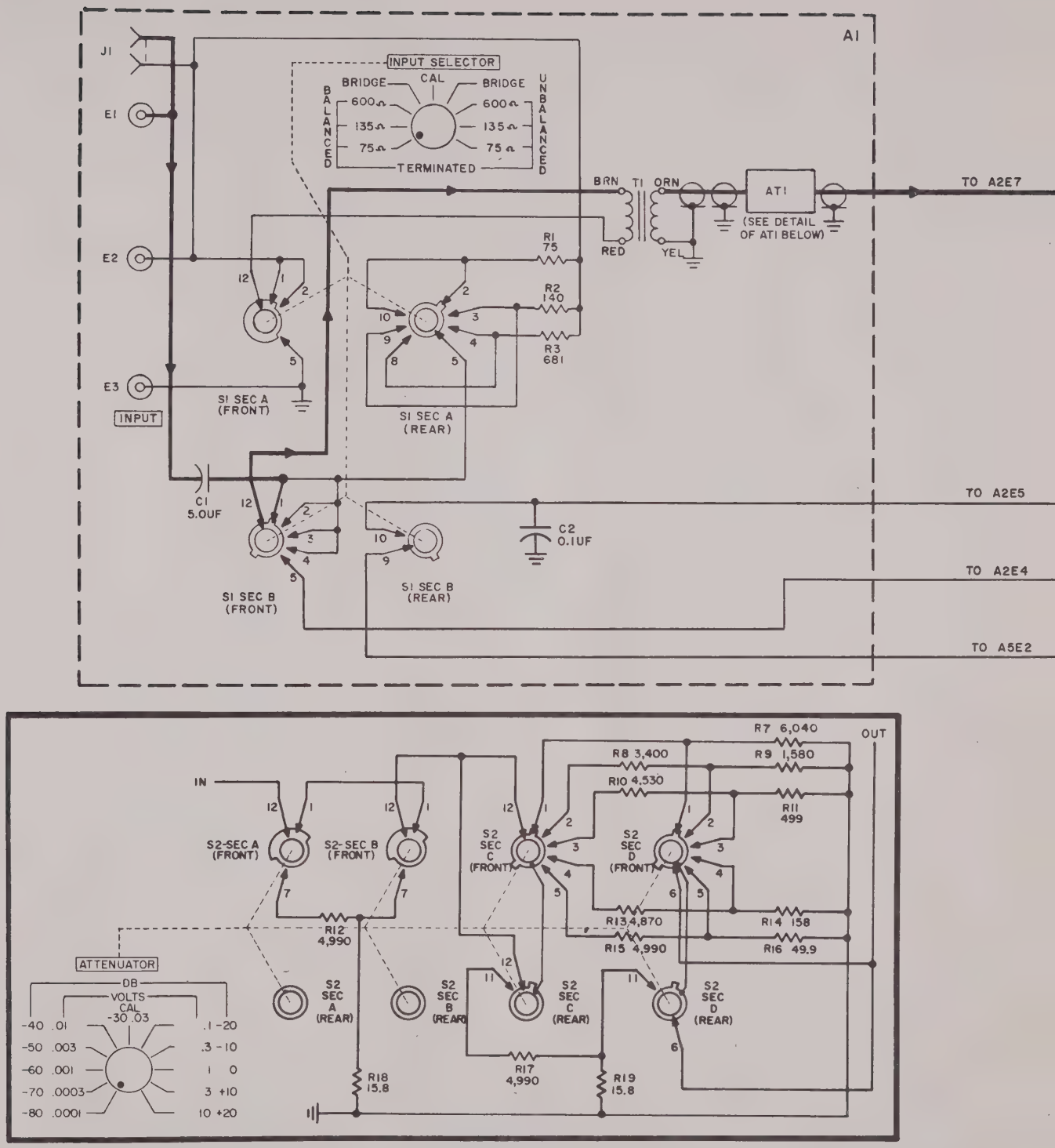



ATTENUATOR AT1 PART OF MODULE A1 ABOVE

Figure 12B
3126B Input, Schematic

IGNORE THIS NOTE

CAUTION *
CHANGES HAVE BEEN MADE
ON THIS PAGE.
SEE ISSUE SHEET.
12/17/94

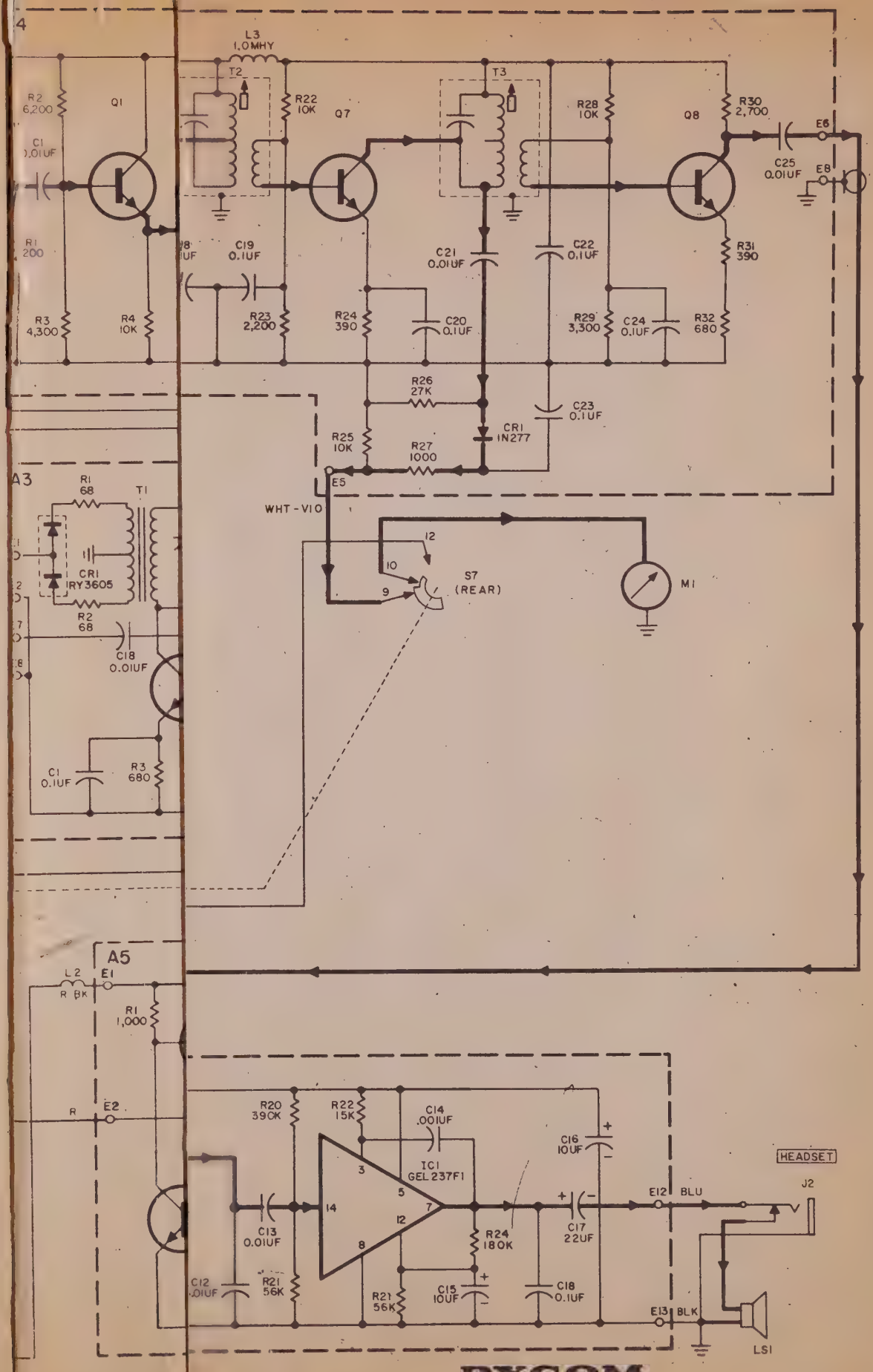






ATTENUATOR AT1 PART OF MODULE A1 ABOVE

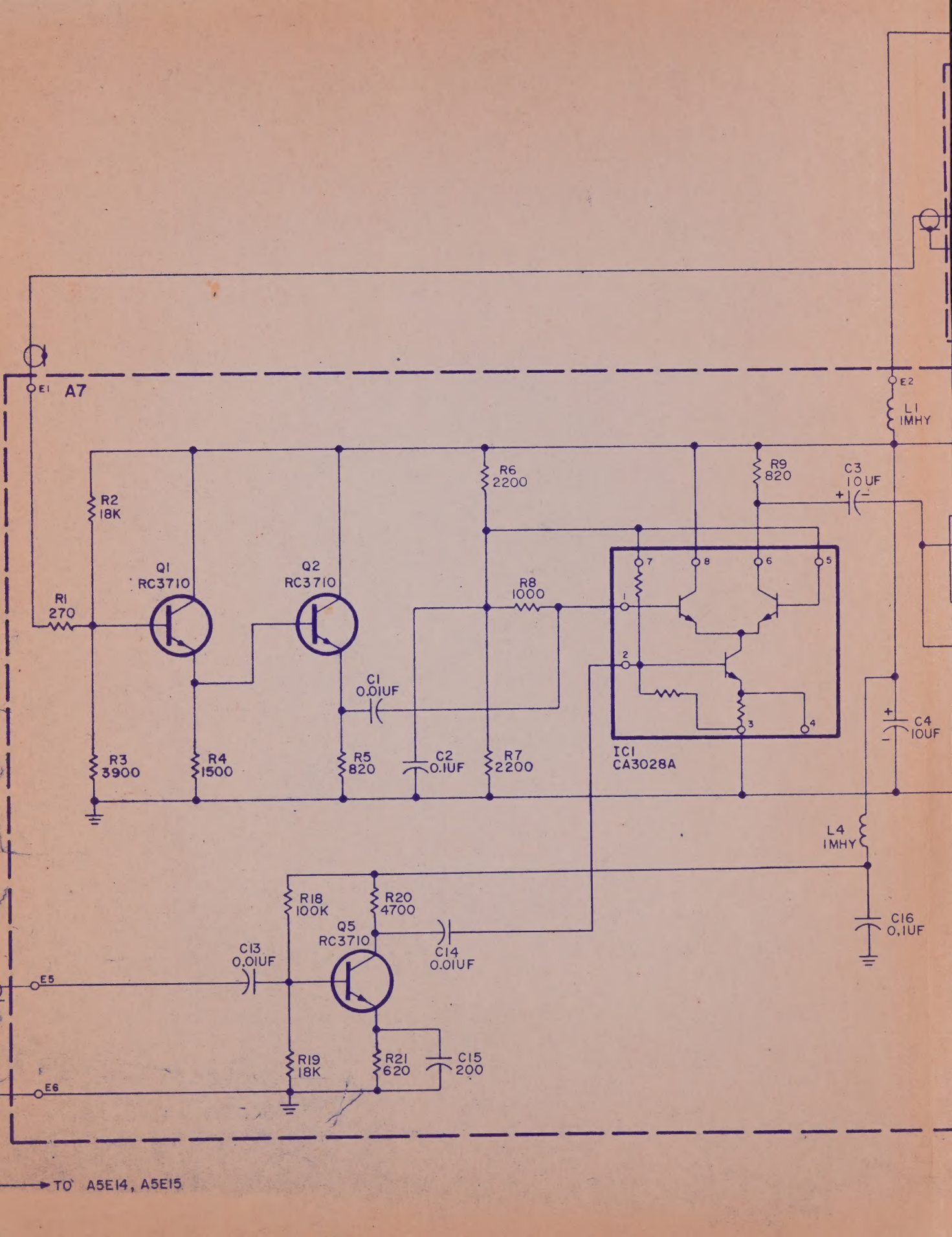
Figure 12C
3132 Input, Schematic

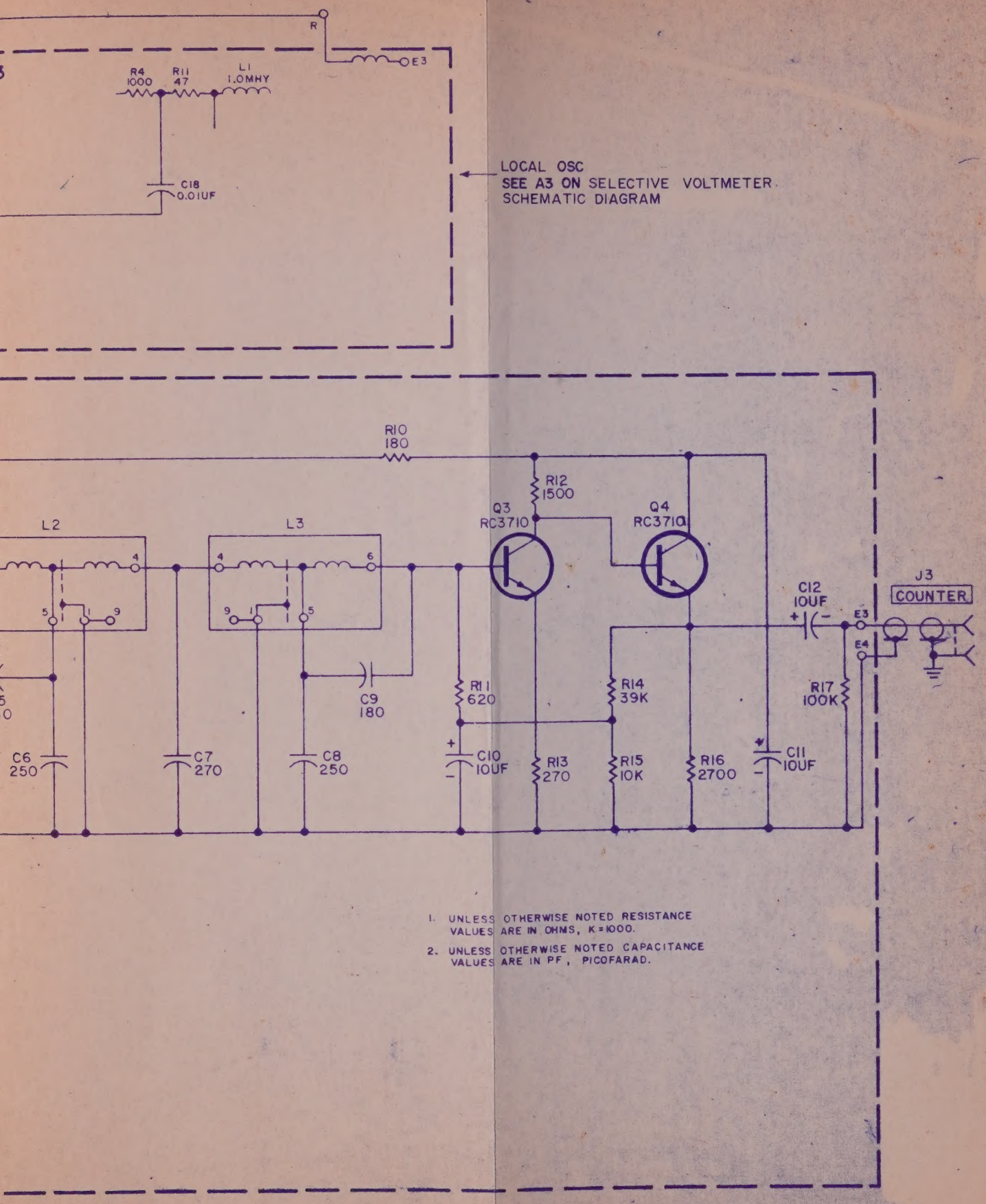



RYCOM INSTRUMENTS

SCHEMATIC DIAGRAM, 3121B, 3126B, 3132 SELECTIVE LEVELMETER

59/60


A7
E1
E2
L1
1MHY
R2
18K
R6
2200
R9
820
C3
10 UF
Q1
RC3710
Q2
RC3710
R1
270
R8
1000
C1
0.01UF
IC1
CA3028A
C4
10UF
R3
3900
R4
1500
R5
820
C2
0.1UF
R7
2200
L4
1MHY
R18
100K
R20
4700
Q5
RC3710
C13
0.01UF
C14
0.01UF
C16
0.1UF
E5
R19
18K
R21
620
C15
200
E6
TO A5E14, A5E15




1. UNLESS OTHERWISE NOTED RESISTANCE VALUES ARE IN OHMS, K=1000.
2. UNLESS OTHERWISE NOTED CAPACITANCE VALUES ARE IN PF, PICOFARAD.

SCHEMATIC DIAGRAM,
TRUE RESTORED FREQUENCY COUNTER OUTPUT

58416